1. Introduction

USA Environment has been retained by Clean Harbors to perform a radiological screening survey of the Wichita, KS facility in order to confirm and supplement data presented in the Kansas Department of Health and Environment report from a 2010 survey of the same property.[1] The site is located at 2549 North New York Avenue in the north- central portion of Wichita, Kansas. The site is approximately 6 acres and includes open field areas, paved/asphalted areas as well as several structures. Adjacent properties include the Missouri Pacific Railroad (MoPac RR) and the Union Pacific Railroad (UPRR) facilities to the north and west, and the former El Paso Corporation refinery to the south (previously decommissioned and demolished by USA Environment LP). The site is additionally bordered by New York Avenue, East Fork of Chisholm Creek, Hwy I-135 and a residential area are to the east.

The site was formerly owned and operated by Reid Supply Company from the mid-1970's to early 1986. Operations conducted during this time frame included hazardous waste operations with spent solvents, spent electroplating baths, and other hazardous sludge.

Although ownership has changed many times since 1986, the property has always been involved with chemical processing and waste management activities. Solvents that had been used with radioluminescent (radium) paints are known to have been one of the chemicals processed at this facility. Exact quantities or concentrations of radium in these solvents are not known. Likewise, data concerning the specific handling/processing protocols for these radium-impacted solvents is not known. The Kansas Department of Health and environment conducted a screening surface survey of the site in October of 2009. Several portions of the site were determined by KDHE to be impacted by radium based on this survey. One section was found to have elevated gamma radiation levels of 35 μR/hr, approximately three times the assumed background of 10 μR/hr. Soil sampling or gamma spectroscopy was not conducted at this time. Based on this screening survey, KDHE concluded that a specific radioactive materials license is required for any activities being conducted on this property.

USA Environment was retained by Clean Harbors in order to provide a specific radioactive materials license and radiologic safety oversight for activities to be conducted during characterization and remediation of the facility. In order to provide a work plan for the radiologic oversight, USA Environment requested additional data concerning radiological characterization of the assumed radium-impacted portions of the site. Since more detailed data was not available, USA Environment developed a workplan to gather the required data. This workplan included detailed walkover gamma combined with GPS logging data survey of the assumed impacted locations and biased soil sampling based on past and present survey results. USA Environment mobilized to the site twice to conduct walkover surveys and soil sampling. The surveys and sampling are discussed further in the sections below.

2. Radiological Survey

USA Environment first mobilized to the site on Thursday August 15th, 2013 in order to conduct the walkover survey and soil sampling. Due to heavy rains over the previous two weeks, the site conditions were less than ideal for surveying due to saturated ground and standing water in several locations. However, the areas designated as radium-impacted by the previous KDHE survey were accessible and the activities proceeded as planned. During the downloading of the files from the data-logger, errors were encountered that resulted in corrupt, unreadable data. Despite several attempts to recover the data, they were deemed irrecoverable and a second survey scheduled. USA Environment remobilized to the site on September 9th, 2013 in order to repeat the walkover survey and procure additional soil samples.

The walkover surveys utilized gamma-ray, 3"x3" NaI scintillation detectors coupled to Ludlum 2241-3 survey meters, a sub- meter global positioning systems (GPS), and data loggers to automatically record the radiation levels and their locations as the field operator performs the walkover. Figure 1 displays the aerial view of the site with the individual survey units outlined. Based on the initial KDHE report, units 1, 2, 3,12, and 13 were assumed to be impacted, units 4, 5, 6, 14, 15, 16, and 17 potentially impacted, and the remainder of the units having a low probability of being impacted.

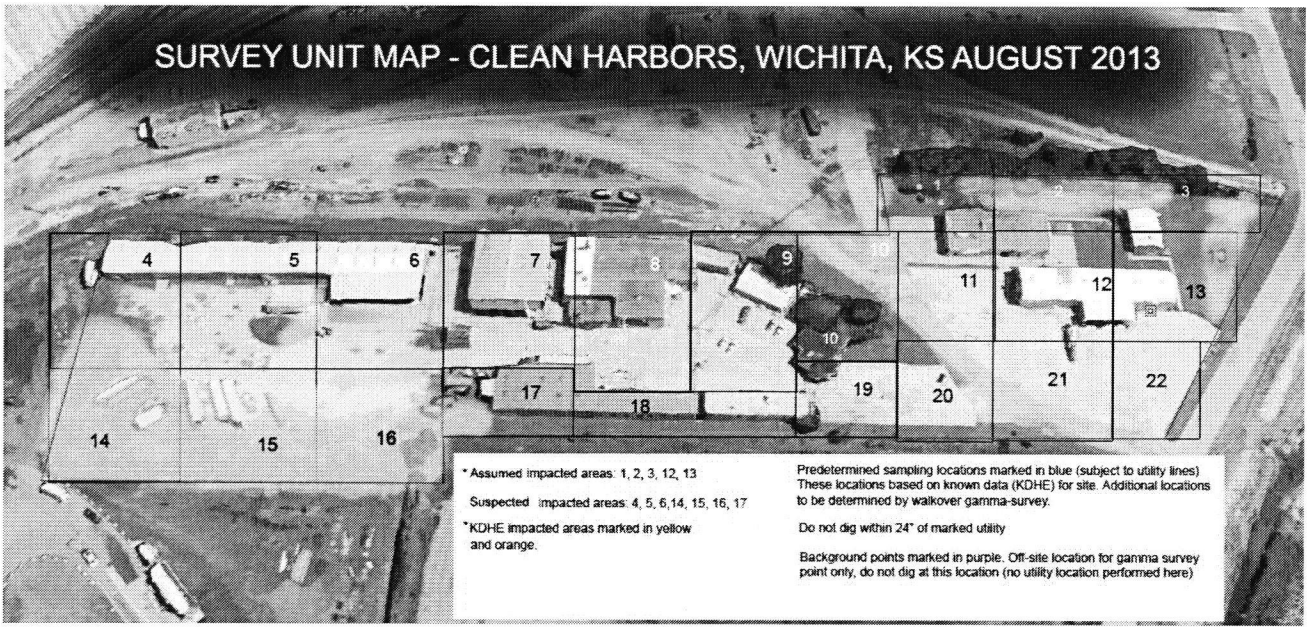

Figure 1. Clean harbors Facility divided into 22 survey units with the KDHE assumed contaminated zones highlighted.

The survey over the assumed-impacted areas was conducted with the detectors mounted 15 cm (6") above the ground, with the technician walking traverses across the survey units with a 1m traverse spacing. This approach provides the field survey operator with continuous measures (once per second) of the distance to the right or left of a target traverse line, guiding the course corrections to follow the target line within approximately 0.5 m. Together, the successive traverses form a serpentine pattern that provides approximately one radiation measurement in every 1 m^2 area based on a traverse spacing of 1 meter (m) and a walking velocity of 0.5 m/s.

Areas of lower probability were walked with a wider traverse spacing of 3 m. These areas were suspected of having diffuse contamination spread uniformly across the areas as depicted by the previous KDHE survey. Paved surfaces such as parking lots were not previously identified as impacted and were assumed to be of very low probability of being contaminated. These areas received only individual, sparsely-distributed survey points.

2.1 Survey Sensitivities, Detection Limits and Field Instrumentation

The following radiological field survey instruments will be used with the detection sensitivities having been determined following the guidance of NUREG-1507 using nominal literature values for background, response, and site conditions for the Ludlum detectors.

All walkover surveys were performed using 3" x 3" sodium iodide (Nal) scintillation detectors (Model 44-20, Ludlum Measurements Inc., Sweetwater, TX) coupled serially to count rate meters (Model 2241-3, Ludlum). The survey meters were coupled in turn to sub-meter global positioning systems (GPS) (Trimble Pro XRS) to automatically record detector positions every second. The data logger used to store the detector positions recorded the gamma radiation exposure rates (cpm) every two seconds. The logged data from the survey meters and GPS systems was downloaded daily to field computers for transfer and analysis.

Since all the detectors were calibrated to cesium-137 efficiency sources, a direct reading of μR/hr cannot be determined due to the variance in energy response of NaI to gamma radiation. Instead, direct measurements were made in units of counts per minute. A Ludlum model 19 survey meter , which has a uniform energy response across the energies associated with radium-226 and efficiency sources was then used to conduct gamma exposure rate surveys at the sampling locations. The readings in μR/hr were then correlated to the direct cpm measurements taken at the identical locations using the Ludlum 4421-3 survey meter with the 3"x3" NaI detector. A table containing the specific measurements made using each detector for each of the sampling locations is contained in Appendix III. Figure 2 below graphically displays this data and the correlation for converting cpm measurements to μR/hr.

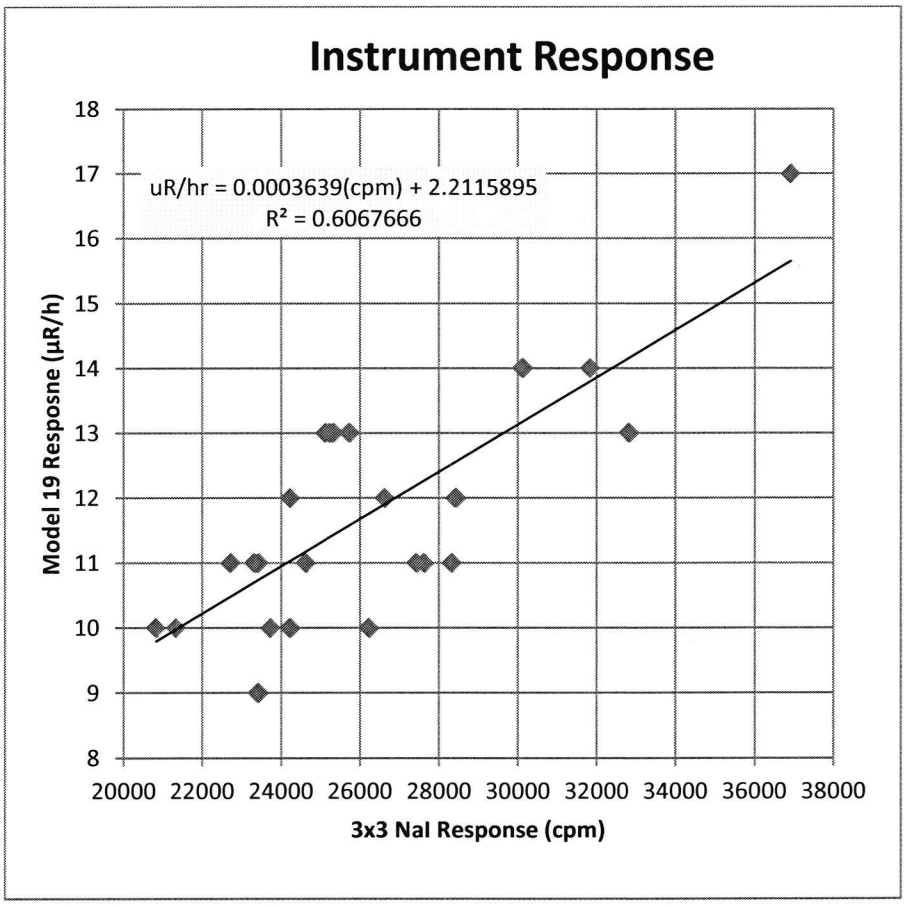

Figure 2. NaI detector response correlated to the Model 19 Response in order to determine μR/hr gamma exposure measurements from cpm data.

All instrumentation were calibrated (within the past 12 months). Daily field performance checks (i.e. background and source check) were conducted in accordance with individual instrument use procedures. These performance checks were performed prior to daily field activities and at any time the instrument response appears questionable. Calibration records for the detectors used are included as an appendix to this report.

2.2 Soil Sampling

Several locations were preselected for sampling based on the KDHE survey data. Additional locations were to have been selected based on an action level of 20 μR/hr. In the absence of any areas meeting the action level, sampling locations were to be selected based on the available data and the judgment of the field technicians in order to obtain representative data for the site. A total of 15 discrete locations were selected for sampling. During the initial mobilization to the site, 10 locations were sampled. These are depicted on Figure 3 as sampling locations 1a, 1b, 2, 5, 10a, 13, 14, 15, 17, 21 where the number represents the survey unit location the samples were collected from. The remaining 5 locations (4, 13b, 16, 18, 19) were sampled during the subsequent mobilization to the site along with an additional 10-point composite sample was collected across an area in Unit 1 based on analytical data obtained from the first mobilization's data set. This was overtop the location of the former drain line.

Each sampling location had one sample from the top 12" of soil depth and one sample from the second 12" of soil depth (12"-24" below surface) collected. All samples were analyzed via gamma spectroscopy by Eberline Services in OakRidge, TN. In addition, the 10-point composite was collected evenly distributed across an area identified as previously containing a drain system. Soil data from the top 12" indicated levels slightly elevated from background concentrations. In order to compare concentrations to KDHE limits, samples were collected to a depth of 15 cm (6"). Analytical reports for all sampling locations are contained in Appendix II of this report.

3.0 Survey and Sampling Results

Figure 3 displays the survey results and sampling locations overlaid onto satellite imagery of the facility. (A larger version of this map is contained in Appendix I) Gamma survey results were unremarkable in that the action level of 20 μR/hr was never recorded in any area surveyed. The maximum gamma radiation levels were found to be only 16 μR/hr.

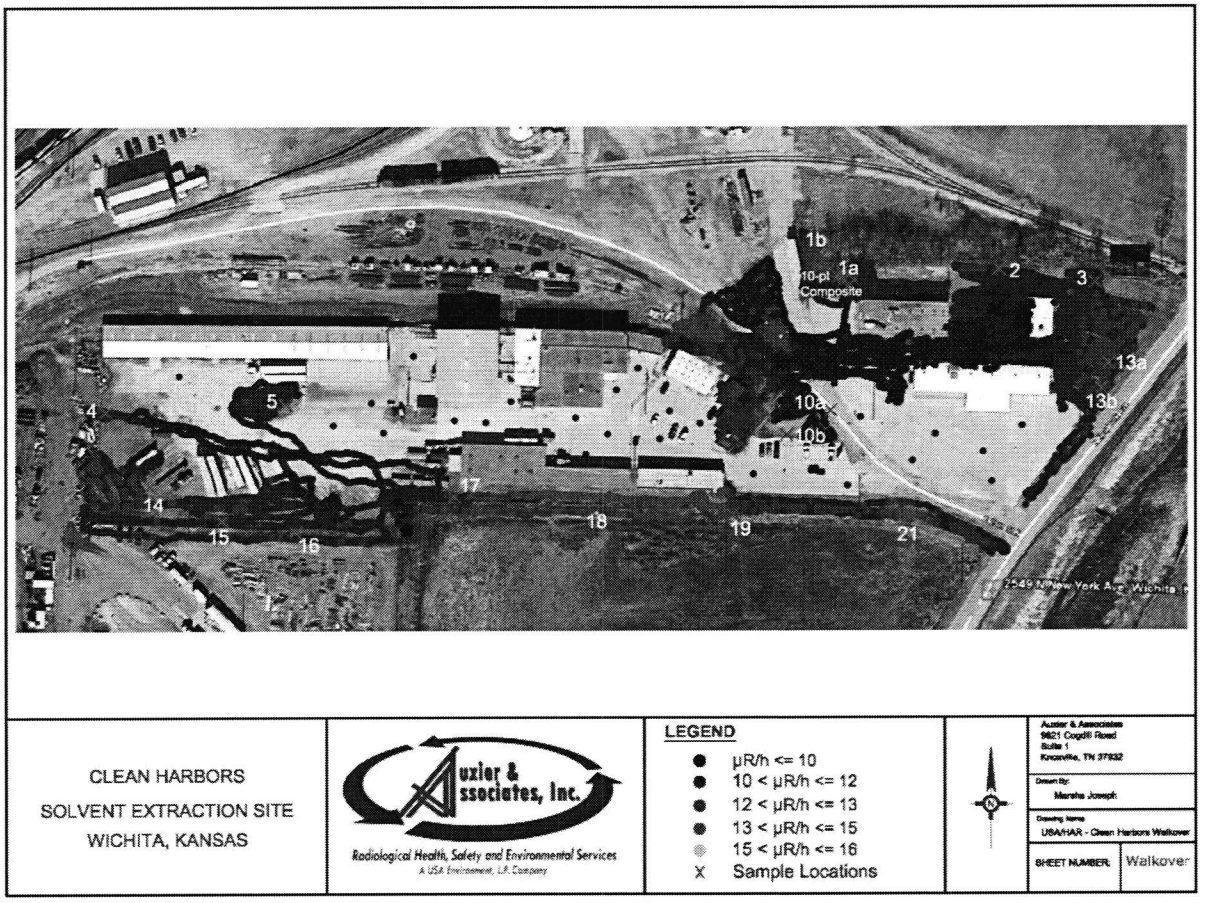

Figure 3. Survey results and sampling locations.

The minimum, median, maximum and average values of measurements recorded are listed in Table 1. The median value corresponded to on-site areas assumed to be non-impacted (Southeast corner near sample location 21and employee parking areas) and was determined to be 11 μR/hr. An off-site location over similar soil (shown in upper Northeast corner of map in Figure 1 on the public right-of-way alongside HWY I-135) was also found to be 11 μR/hr. This is consistent with typical background measurements across this region of the United States and was used as the background gamma exposure rate for this facility. Measurements displayed on the map were color-coded based on their values as compared to the average. Table 1 lists the statistical data for the distribution. Measurements greater than two standard deviations above the average were assumed to be "elevated" levels and are depicted in light green on the survey map. Although elevated above the determined background, elevated results did not indicate significant widespread contamination.

Table 1. Statistical data for survey results

	cpm	uR/hr	
min	11230	6	
median	22730	11	
65.0%	24350	11	
85.0%	26430	12	
90.0%	27230	12	
95.0%	28830	13	
97.5%	30230	13	
100.0%	35930	15	
Max	38530	16	
Average	22600	10.4	
StDev	3850		
Avg + σ	26449	11.8	
Avg + 2σ	30299	13.2	

Figure 4 shows the soil sampling data in comparison to EPA guidelines for allowable soil concentrations of radium-226. Table 2 lists the analytical data obtained from the soil samples collected. Sample results ranged from 0.62 to 3.60 pCi/g of radium -226. According to KDHE literature, typical background concentrations of radium-226 for this region ranges from 1-4 pCi/g.[2] Based on the median soil sample results, background concentrations of radium-226 were 1.1 pCi/g. Only two locations resulted in radium-226 concentrations statistically significant from background. The two were 2.5 and 3.6 pCi/g and occurred in the section that had previously contained the drain.

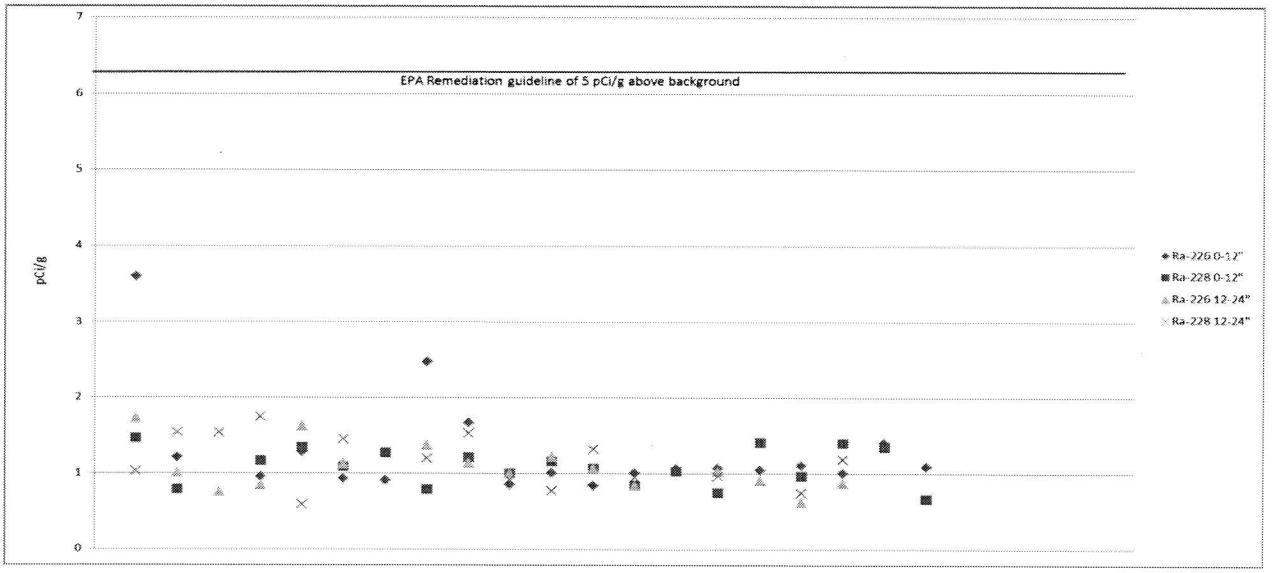

Figure 4. Graphical representation of sampling data relative to EPA guidelines.

Table 2. Soil sampling summary data. All values in pCi/g.

Depth	0-12"			12-24"		
	Ra-226 0-12"	Ra-228 0-12"	K-40	Ra-226 12-24"	Ra-228 12-24"	K-40
1A	3.6	1.46	17.2	1.73	1.03	18.2
1B dup	1.21	0.79	14	1.01	1.54	20.6
1B				0.76	1.53	20.8
2	0.955	1.17	17.4	0.85	1.74	18.4
3	1.28	1.34	18.5	1.62	0.59	7.14
4 dup	0.93	1.09	21.9	1.13	1.45	20.4
4	0.91	1.27	22.1			
5	2.47	0.79	18.6	1.37	1.2	19.8
10	1.67	1.21	23	1.14	1.53	20.7
13A	0.86	1.01	19.6	1	0.91	16.8
13B	1.01	1.16	18.3	1.22	0.77	15.9
14	0.84	1.07	21.8	1.07	1.32	19.4
15 dup	1.01	0.85	17.3	0.84	0.95	21.5
15	1.06	1.03	17.7			
16	1.07	0.75	21.8	1.03	0.96	17.3
17	1.05	1.41	22.1	0.91	1.41	20.2
18	1.11	0.97	17.3	0.62	0.74	23.5
19	1.01	1.4	22	0.87	1.18	22.5
21	1.4	1.35	29.7			
composite	1.09	0.67	13.4			
Avg	1.29	1.09	19.67	1.07	1.18	18.95
AVG BKG	1.09	1.09	19.67	1.00	1.18	18.95

4.0 Discussion

Survey results obtained by KDHE in 2010 could not be repeated for any of the assumed impacted areas of the facility. The conclusion drawn in 2010 was that the facility contained numerous locations where soil concentrations of radium-226 were assumed to be greater than 5 pCi/g above background based on surface gamma exposure rates of up to 35 μR/hr being measured in isolated locations with an assumed background exposure rate of 10 μR/hr. However, the current maximum gamma radiation level detected was only 16 μR/hr. Measurements a few μR/hr above background (12-14 μR/hr) were obtained in several locations across the site, however soil sampling results did not support an assumption of elevated levels of radium-226 based on these levels. The facility contains a wide variety of soil, gravel and rock types. Different soil types will contain different levels of naturally occurring radioactive material (NORM). Potassium-40 concentrations, a naturally occurring radionuclide with a high energy gamma, were determined to be in the high end of known background level ranges. As a gamma emitter, this could partially account for slight variances in gamma measurements across the site areas associated with compacted crushed rock containing higher levels of K-40 or other naturally occurring gamma emitting isotopes. Several of the locations, such as sample locations 18, 19 and 21 also contained K-40 concentrations above 20 pCi/g at either the first or second sampling depth. No historical evidence was provided to indicate potentially buried material that could result in subsurface concentrations of radium in the absence of surface deposits, other than the drain location in the Northeast corner of the facility.

The only location where the slightly elevated gamma measurements and soil concentrations indicated potential radium contamination from past processes was in the Northeastern portion of the site associated with hazardous drum storage and handling as well as a drain assembly that has been removed and back-filled at some point in the past. Soil sample results indicate that the elevated radium-226 concentrations were limited to the upper 12" of soil depth consistent with material that may have been spilled during drum handling processes. However, the elevated concentrations in these areas were less than 3 pCi/g above background levels in discrete locations and would not require remediation as a radiologically contaminated area under EPA guidelines. In addition, EPA and KDHE guidelines allow for averaging soil concentrations over $100m^2$ for the upper 15cm depth. The 10-point composite sample was representative of the upper 15 cm depth over approximately $10m^2$ covering the area associated with the historic drain location. Even averaged over this small of an area, the average concentration was found to be consistent with background levels. No data was collected that suggested soil concentrations exceeded 5 pCi/g above background levels down to a depth of 24". If radium contamination was the results of surface deposits, adverse weather over two years could account for the removal of surface contamination and the lower gamma radiation levels measured during this survey as compared to the measurements conducted in 2010. No soil sampling was conducted in 2010 for comparison to current data.

The location associated with the historic drain location was found to have bull rock with stabilizing sand beginning at approximately 6" depth and extending fully down to the 24" depth sampled during this scoping survey. Again, soil samples collected indicated any residual radium contamination was limited to the upper 12" of soil, however, the depth of the drain or soil conditions beyond 24" were not evaluated during this scoping survey. This area extends from the Northwest corner of the building in Unit 1 and approximately 40 feet to the Northwest to a shallow ditch adjacent to the vehicle right of way.

5.0 Conclusion

Assumptions for this site were that radium contaminated solvents leaked onto the surface across various locations on-site. In addition, there is suspicion that material may been discharged through a drainline previously located in the Northeast corner of the property. If years of contamination leaking onto the surface of the facility had caused site-wide contamination in excess of 5 pCi/g above background, radium deposits in the top 24" of soil should still be detectable via surface gamma scintillation detection and soil sampling. No information was found to indicate radium deposits would have been due to anything other than surface discharges with the exception of the drain location. Soil sampling combined with a walk-over gamma survey support the assumption that the majority of the facility has not been impacted by radium contamination. The portions of the site that have been linked to low levels of radium contamination do not indicate significant soil concentrations that would require remediation under any state or federal guidelines, based on the best available data.

References:

1. Unified Focused Assessment Report for the Safety Kleen (Wichita) Site (Reid Supply), Wichita, Sedgwick County, Kansas, KDHE I.D. No. # C208770722, Jan. 2010.

2. Naturally Ocurring Radioactive Material, KDHE Radiation Control Program, http://www.kdheks.gov/radiation/download/NORM_Info.pdf, June 2010

APPENDIX F

ECOLOGICAL RISK ASSESSMENT, RBR CONSULTING

Risk-Based Remedies
RBR Consulting, Inc.

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

FOR THE

CLEAN HARBORS KANSAS LLC PROPERTY
WICHITA, KANSAS

Prepared For:

Cameron-Cole LLC
Boulder, Colorado

Prepared By:

Risk-Based Remedies
RBR Consulting, Inc.
Beaver Falls, Pennsylvania

December 2013

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EXECUTIVE SUMMARY

This Screening Level Ecological Risk Assessment (SLERA) has been completed on behalf of Cameron-Cole, LLC, for the Clean Harbors Kansas, LLC site located in Wichita, Kansas (site). The SLERA has been conducted in accordance with guidance from the United States Environmental Protection Agency (USEPA).

The SLERA summarizes relevant site background information and investigation results upon which the assessment is based. This includes a description of the site and environmental setting, a summary of the analytical data that are utilized in the assessment, and the results of a benthic macroinvertebrate survey that was conducted at the site. The SLERA focuses on habitat associated with the East Fork of Chisholm Creek adjacent to the site. Due to the industrial development of the site itself, there is insufficient habitat to warrant quantitative ecological evaluation, and exposure by terrestrial receptors on the site is considered to be de minimis.

The screening-level problem formulation phase of the SLERA includes all components outlined in USEPA guidance: (1) identification of constituents associated with the site; (2) mechanisms of ecotoxicity; (3) fate and transport, ecosystems potentially at risk, and complete exposure pathways; (4) assessment endpoints; and (5) risk questions and measurement endpoints. Based on the available site information and the objectives of the SLERA, the following potentially complete exposure pathways were identified for aqutatic organisms (e.g., plants, invertebrates and fish) in Chisholm Creek: (1) direct contact with sediment; (2) direct contact with surface water; and (3) direct contact with pore water. Quantiative evaluation of potentially complete pathways for higher order ecological receptors (e.g., mammals and birds) was not warranted.

Specific assessment and measurement endpoints were identified to address the potentially complete exposure pathways. The assessment endpoints relate to sustainability (growth, reproduction and survival) of aquatic organisms, and to the diversity and abundance of populations of benthic invertebrates. The measurement endpoints selected for evaluation in this SLERA consist of a comparison of measured concentrations of constituents to levels reported to cause adverse effects; evaluation of macroinvertebrate community metrics; and comparison of the results for site locations with the results for reference locations.

The comparison of sediment, surface water, and pore water data to generic ecological screening benchmarks indicated a small number of exceedances. In sediments, three inorganics (arsenic, barium, and lead) and one organic (acenaphthene) were detected at concentrations exceeding the screening benchmarks. All other constituents were either non-detect, or detected below the screening benchmark.

Acenaphthene and arsenic were detected in only one sample each above their threshold effects concentration (TEC), and there were no exceedances of the probable effects concentration (PEC). As such, these two constituents were determined to have neglible potential for adverse effects. For barium and lead, the sample-by-sample sediment concentrations warranted additional review in conjunction with the results of the macroinvertebrate survey.

In surface water, only one constituent (1,1,1-trichloroethane) was detected above the surface water screening benchmark. The exceedance was detected in the upstream reference location, and none of the samples collected adjacent to the site showed detectable concentrations of 1,1,1-trichloroethane. As such, this constituent was determined to have neglible potential for adverse effects. In pore water, there were no constituents detected at concentrations above the surface water screening benchmarks.

The results of the macroinvertebrate survey indicated that, in comparison to the reference location, three of the five samples from the East Fork of Chisholm Creek suggested "nonimpaired" habitat, one sample fell in between the range of "nonimpaired" and "slightly impaired" habitat, and one sample indicated a "slightly impaired habitat". A comparison of the analytical data to macroinvertebrate results and habitat parameters was completed to determine whether the analytical data could be correlated to the macroinvertebrate results. The results do not correlate with a conclusion that any potential impairment is site-originated. A summary of the results for each of the sampling locations on the East Fork of Chisholm Creek is presented below.

- **ECO-1A**: The macroinvertebrate results for this sample, located 2,000 feet downstream of the site, indicate an invertebrate community that falls in between the range of "nonimpaired" and "slightly impaired". The sediment sample collected nearest to this location (CC-11) indicated that barium was detected at a concentration above its TEC; however, this was the case for all sediment samples (including the reference sample). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. In addition, the pore water sample (PW-11) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1A suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-1B**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-7) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment

samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-1 and SR-SW-1) and pore water sample (PW-1) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1B suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-2**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-5) indicated that barium and lead were detected at concentrations above their TECs (lead was below its PEC). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The distribution of concentrations of both barium and lead do not refect a pattern suggesting that they are related to a site-associated source. The surface water samples (SW-BS-2, SR-SW-2) and pore water sample (PW-5) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-2 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-3**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-4) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-3 and SR-SW-3) and pore water sample (PW-4) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-3 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-4**: The macroinvertebrate results for this sample, the closest sampling point to the site, indicate "slightly impaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-3) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-4 and SR-SW-4) and pore water sample (PW-3) collected

nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-4 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location. The "slightly impaired" macroinvertebrate community is more likely to be associated with differences in the physical habitat between ECO-4 and the upstream reference location.

- **ECO-5:** Because ECO-5 is the reference sample, it is not assigned a biological condition category. However, as evidenced by the fact that the majority of site samples fell into the "nonimpaired" category, the specific macroinvertebrate results for this sample were generally comparable to the other locations. The sediment sample collected nearest to this location (CC-5) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The pore water sample (PW-5) collected nearest to this location also indicated that no constituents were detected above the surface water quality benchmarks. In surface water, the concentration of 1,1,1-trichloroethane from sample SR-SW-5 slightly exceeded the benchmark. However, the result from sample SW-BD-5 was non-detect. Because this location is upstream of the site, and because 1,1,1-trichloroethane was not detected above the benchmark in the other surface water or pore water samples included in this evaluation, it is not considered to be of further concern.

The current observations indicate that macroinvertebrate populations in the East Fork of Chisholm Creek adjacent to the site do not appear to be adversely affected by constituent releases from the site, nor would such an effect be expected in the future since on-site conditions should continue to improve over time. The results suggesting "slightly impaired" habitat in the vicinity of the site (e.g., ECO-4) are most likely associated with variations in habitat that were observed during the sampling procedure.

1.0 INTRODUCTION

This Screening Level Ecological Risk Assessment (SLERA) has been completed on behalf of Cameron-Cole, LLC, for the Clean Harbors Kansas, LLC site located in Wichita, Kansas (site). Consistent with the requirements of the United States Environmental Protection Agency (USEPA), the SLERA consists of quantitative and qualitative analyses of the potential for adverse effects to ecological receptors and habitat which may be associated with constituents present in environmental media at the site.

This report has been prepared in accordance with the USEPA's (1997) "Ecological Risk Assessment Guidance for Superfund," which indicates that an ecological risk assessment process should consist of eight major steps:

1) Screening-Level Problem Formulation and Ecological Effects Evaluation
2) Screening-Level Preliminary Exposure Estimate and Risk Calculation
3) Baseline Risk Assessment Problem Formulation
4) Study Design and Data Quality Objectives
5) Field Verification of Sampling Design
6) Site Investigation and Analysis of Exposure and Effects
7) Risk Characterization
8) Risk Management

The first two steps comprise the SLERA process, while the remaining six steps are the baseline ecological risk assessment (BERA). The SLERA uses existing environmental data combined with very conservative assumptions to identify potential risks. The information, evaluations, and risk calculations developed in the SLERA lead to a Scientific Management Decision Point. At this point, there are three possible actions: (1) determination that there is no potential for risk and therefore no need for further action at the site; (2) determination that there is the potential for risk, but more definitive data and a BERA are required; or (3) there is a substantive demonstration of risk and a need to proceed directly to an evaluation of remedial measures.

The remainder of this document presents the relevant information for Steps 1 and 2 of the ecological risk assessment process. The SLERA incorporates agency comments on the RCRA Facility Investigation (RFI) Supplemental Phase IV Work Plan, as well as recent data collected from the site.

2.0 SITE BACKGROUND

This section presents relevant site background information, including a physical description of the site, ecological habitat and potential receptors species, and a description of the sampling events relevant to the SLERA.

2.1 SITE HISTORY AND DESCRIPTION

The Clean Harbors Kansas, LLC site (EPA Identification Number KSD007246846) is approximately six acres in size and is located at 2549 North New York Street in an industrialized area of Sedgwick County, Wichita, Kansas, approximately three miles north of the city. The site is bordered by the El Paso Corporation (formerly Coastal Derby) refinery to the south and west and a Union Pacific Railroad rail yard to the north. North New York Street, the East Fork of Chisholm Creek, and the Interstate-135 lie east of the site. Farmland Elevator Facility lies approximately 500 feet northwest of the facility. A site map is presented as Figure 2-1.

The facility lies within the tributary basin for the Arkansas River. Drainage from the facility is to tributaries of Chisholm Creek, which is a tributary to the Arkansas River. The East Fork of Chisholm Creek is the closest surface water body to the site. It is located about 150 feet east of the property and flows to the south. The West Fork of Chisholm Creek is located about 2,000 feet west of the site. These streams discharge to the Arkansas River about three miles south of the site. The Arkansas River flows to the east. The Little Arkansas River lies two miles west of the site and flows to the south into the Arkansas River. The confluence of the Little Arkansas and the Arkansas River is approximately three miles southwest of the site.

The site is a hazardous waste management facility operating under a RCRA Part I permit that has been used for manufacturing and/or chemical waste handling for approximately 60 years. Accompanying this operating permit was a Corrective Action Permit (Part II) issued under the authority of the Hazardous and Solid Waste Amendments to RCRA. The facility is permitted to conduct regulated waste management activities including the storage, treatment, and recovery for recycling of hazardous and non-hazardous wastes. Wastes handled at the facility include paints (and related wastes), batteries, fluorescent lights, incinerable hazardous solids, lab packs, mercury, household hazardous wastes, off-specification and production wastes from industries, both chlorinated and non-chlorinated petroleum-based waste solvents, plating wastes, and corrosives. Wastes that are received at the facility are reclaimed or directed to an appropriate facility for handling.

The site lies within the North Industrial Corridor (NIC), which includes most of the industrial corridor near the facility. The NIC, which includes over 4,000 acres of property, has been identified as having a

dissolved groundwater plume of chlorinated volatile organic compounds (VOCs) present. Local land use, as reported in the NIC RI Report (CDM, 2002), includes agriculture (339 acres), parks (57 acres), schools (9 acres), hospitals (45 acres), residential (490 acres), vacant (149 acres), and commercial/industrial (2,922 acres). The NIC is undergoing its own environmental investigation of a dissolved chlorinated VOC plume under the supervision of the City of Wichita, with oversight by KDHE. A City of Wichita ordinance (Ord. No. 43-156 S 2) is in place that prohibits installation of groundwater wells for personal use within the NIC. Personal use is defined in the ordinance as "the use of water from a well for purposes including drinking, cooking, bathing, and sewage disposal".

The site is comprised of several solid waste management units (SWMUs), areas of concern (AOCs), and other areas (OAs) that were investigated during previous RFI activities. There are also ten buildings at the site labeled Buildings A through K, as well as a Processing Area and Drum Dock that are open areas covered by a roof. Detailed descriptions of all SWMUs, AOCs, OAs, and buildings are provided in the RFI Report (Cameron-Cole, 2005).

2.2 ECOLOGICAL HABITATS AND RECEPTORS OF INTEREST

As described above, the site is an active hazardous waste management facility consisting of several buildings, a Processing Area and Drum Dock that are open areas covered by a roof, and areas covered with pavement and gravel. Based on these observations, there is insufficient habitat at the site to warrant quantitative ecological evaluation. Therefore, exposure by terrestrial receptors via soil pathways is considered to be de minimis for this site.

The primary habitats of interest for the site are the aquatic and riparian habitats associated with Chisholm Creek. At the time of the ecological field investigation (October 2013), the reach of the creek adjacent to the site was shallow, ranging from zero to three feet in depth, and the flow was very slow and nearly imperceptible at some locations. The creek width ranged from 10 to 20 feet, while no canopy was present as very few, if any, mature trees were nearby. The riparian zone surrounding the creek varied in width from 20 feet of mild, intermittent grassy vegetation south of the site, to 30 feet of rich, dense grassy/shrubby vegetation north of and adjacent to the site. Fish (minnows as well as larger specimens) were observed in some of the sampling locations, and several species of macroinvertebrates (including clams, crayfish and dragonfly/damselfly larvae) were observed and collected. The macroinvertebrates were evaluated quantitatively in this report. No other wetland or aquatic habitat was observed on or immediately adjacent to the site. To further assess the presence of aquatic habitats on and adjacent to the site, a review of the National Wetlands Inventory (NWI) database was completed (USFWS, 2013).

The NWI map of the site is included as Figure 2-2. As shown on this figure, there are no wetlands identified on or immediately adjacent to the site. The East Fork of Chisholm Creek is shown on the map,

but no wetland areas are identified for reach of the creek adjacent to or downstream of the site. Approximately 1,250 feet north of the site, freshwater emergent wetland and lake areas are identiifed, but there is no potential for impacts from the site to these locations. Based on this review, there are no wetland habitats associated with the site that warrant evaluation.

A literature review was conducted to determine the potential presence of threatened or endangered species in the vicinity of the site. The Kansas Department of Wildlife, Parks and Tourism (KDWPT) provides lists of potential threatened and endangered species for each county in the state. The KDWPT listing of species for Sedgwick County is provided in Appendix A. As indicated in this listing, one species of mammal (eastern spotted skunk), five species of fish (Arkansas darter; Arkansas River speckled chub; silver chub; plains minnow; and Arkansas River shiner), and four species of birds (eskimo curlew; piping plover; snowy plover; and least tern), are identified as state-threatened or endangered with potential presence within Sedgwick County. None of these species have been documented as being observed at the site, and the likelihood of their presence is considered to be minimal.

2.3 MACROINVERTEBRATE SAMPLING

Macroinvertebrate sampling of the East Fork of Chisholm Creek was conducted by RBR on October 3, 2013. The survey was conducted in order to assess the biotic integrity of the stream. Macroinvertebrate samples were collected from six locations in the East Fork of Chisholm Creek (including one upstream reference location). Figure 2-1 presents the approximate locations of macroinvertebrate samples.

Within the East Fork of Chisholm Creek east of the site, sample ECO-5 was the most upgradient sampling location (about 400 feet upstream from the site) and is considered the upstream reference location. Sample ECO-5 is the only sample collected on the eastern side of Interstate-135. Sample ECO-4 was adjacent to the site, roughly 300 feet downstream from sample ECO-5. Sample ECO-3 was also located adjacent to the site, roughly 300 feet downstream from sample ECO-4 east of the intersection of North New York and East 25th Street North. Sample ECO-2 was located 300 feet downstream from the site and sample ECO-3 east of intersection of North New York and East 24th Street North. Sample ECO-1B was located roughly 750 feet downstream from the site, while sample ECO-1A was located approximately 2,000 feet downstream of the site, just before the 21st Street bridge. Samples ECO-1B through ECO-5 were collected from the same general locations as surface water samples SW-1 through SW-5, historically collected from the creek.

Qualitative kicknet samples were collected following rapid bioassessment protocols (USEPA, 1989, 1999a). Timed qualitative kick samples were collected from each sample location with a 0.6 mm mesh D-ring net. The contents were manipulated by hand to remove rocks, twigs and other large residues that

were not macroinvertebrates. The macroinvertebrates were then transferred to one liter nalgene bottles. The bottles were then filled with isopropyl alcohol for sample preservation.

Habitat Assessment Field Data Sheets for low gradient streams (provided in USEPA guidance) were completed for each sampling location and are provided in Appendix B. A brief description of each sampling location is provided below.

- **ECO-1A** is located approximately 2,000 feet downstream of the site just before the 21st Street bridge. The habitat characteristics include an intermittent moderate to poor quality 20 foot riparian zone with an open canopy (85% to 100% open). The channel width at this location was approximately 20 feet, the depth ranged from 2 to 12 inches, and the surface water had slow flow characteristics. The creek banks and bottom substrate were rocky with some sand.

- **ECO-1B** is located 750 feet downstream of the site. The habitat characteristics include an intermittent moderate quality 30 foot riparian zone with an open canopy (85% to 100% open). The channel width at this location was approximately 15 feet, the depth ranged from 0 to 3 feet, and the surface water had slow flow characteristics. The creek banks and bottom substrate were a mix of 50% rocks and 50% gravel/sand.

- **ECO-2** is located 300 feet downstream of the site, directly east of the intersection of North New York and East 24th Street North. The habitat characteristics include a moderate quality 30 foot riparian zone with an open canopy (85% to 100% open). The channel width at this location was approximately 15 feet, the depth ranged from 0 to 18 inches, and the surface water had slow flow characteristics. The water level was lower in this sampling area than most of the others as sediment islands and rocks were visible within the stream.

- **ECO-3** is located 300 feet downstream from ECO-4, directly east of the intersection of North New York and East 25th Street North. The channel width at this location was approximately 10 feet, the depth ranged from 0 to 12 inches, and the surface water had slow flow characteristics. The water level was lower in this sampling area than most of the others as a large sand bar was visible within the stream.

- **ECO-4** is the closest sampling point to the site, located 100 feet directly east of the site's boundary, roughly 300 feet downstream from ECO-5. The channel width at this location was approximately 15 feet, the depth ranged from 0 to 12 inches, and the

surface water had slow flow characteristics. This habitat was similar to that of sample ECO-3.

- **ECO-5**, which is the upstream reference location for the East Fork of Chisholm Creek and the only sample located northeast of the site and on the eastern side Interstate-135, is located 400 feet upstream from the site. The habitat characteristics include a moderate quality 30 foot riparian zone with an open canopy (85% to 100% open). The channel width at this location was approximately 12 to 15 feet, the depth ranged from 0 to 2 feet, and the surface water had slow flow characteristics. This sampling area had more seaweed and aquatic vegetation than the other sampling locations.

The macroinvertebrate samples were shipped to and analyzed by Normandeau Associates, Inc., who completed a count of individual specimens present in each sample. The macroinvertebrates were identified to the last possible taxon, usually at least the genus, and enumerated. The laboratory result sheets for each sample collected on October 3, 2013 are presented in Appendix C. Table 2-1 presents a list of the locations where macroinvertebrate samples were collected.

2.4 SEDIMENT, SURFACE WATER AND PORE WATER SAMPLING

As part of the semi-annual sampling conducted at the site, surface water samples have been collected from five locations (SW-1 through SW-5) along the East Fork of Chisholm Creek adjacent to the site (refer to Figure 2-3). The most current round of semi-annual surface water samples was collected on October 18, 2013; these five surface water samples (identified as SR-SW-1 through SR-SW-5) are included in the quantitative risk assessment. Five additional surface water samples (identified as SW-BS-1 through SW-BS-5) were collected on the same date to supplement the macroinvertebrate survey. These samples were collected in the same general locations, and are also included in the quantitative risk assessment. Table 2-1 presents a list of the locations where the surface water samples were collected.

It should be noted that surface water samples collected prior to October 2013 are not included in this SLERA. The most recent set of samples is considered to provide the most representative data set, and is consistent with the sampling that was conducted for other media (macroinvertebrates, sediment and pore water).

Sediment and pore water samples were also collected from the East Fork of Chisholm Creek between October 4 and October 11, 2013. Sediment samples were collected from eleven locations (CC-1 through CC-11). Pore water samples were collected from similar locations (PW-1 through PW-11). Figure 2-3 presents the approximate locations of sediment and pore water samples, and Table 2-1 presents a list of the locations where these samples were collected.

The sediment samples were analyzed for semivolatile organic compounds (SVOCs), metals, percent solids and total organic carbon. Surface water samples were analyzed for VOCs, and pore water samples were analyzed for VOCs and toxaphene. Complete analytical data for constituents in sediment are presented in Table D-1 of Appendix D; constituents in surface water are presented in Table D-2; and constituents in pore water are presented in Table D-3.

3.0 SCREENING LEVEL PROBLEM FORMULATION

In accordance with the "Ecological Risk Assessment Guidance for Superfund" (USEPA, 1997), the objectives of the problem formulation phase of an ecological assessment include the following:

- To identify the constituents known to be present or expected to be present at the site,
- To provide information on contaminant fate and transport, complete exposure pathways, and species or ecosystems potentially at risk;
- To characterize ecological effects to be evaluated; and
- To select the assessment and measurement endpoints that will be addressed.

To achieve these objectives, this screening level problem formulation includes the following components:

- Environmental setting and constituents associated with the site;
- Mechanisms of ecotoxicity;
- Evaluation of contaminant fate and transport, ecosystems potentially at risk, and complete exposure pathways;
- Selection of assessment endpoints; and
- Development of risk questions and measurement endpoints.

Each of these components of the screening level problem formulation is discussed in detail in the subsections that follow.

3.1 ENVIRONMENTAL SETTING AND CONSTITUENTS AT THE SITE

Section 2.2 described the environmental setting for the site. Due to the industrial development of the site itself, there is insufficient habitat to warrant quantitative ecological evaluation, and exposure by terrestrial receptors on the site is considered to be de minimis.

The SLERA focuses on habitat associated with the East Fork of Chisholm Creek adjacent to the site.

Historical investigations have indicated that trace concentrations of chlorinated solvents and petroleum hydrocarbon constituents were detected in surface water from the East Fork of Chisholm Creek.

Therefore, supplemental sampling (sediment, surface water and pore water) was conducted to provide a more current and comprehensive characterization of the creek.

As part of this SLERA, a comparison of the analytical data to screening benchmarks is completed to identify constituents of potential ecological concern (COPEC). This comparison is presented in Section 4.1.

3.2 MECHANISMS OF ECOTOXICITY

The mechanisms of toxicity are highly dependent on various factors, including constituent properties, exposure medium and medium properties, receptor species, and exposure routes. For example, aquatic plants may be exposed to constituents in sediment via uptake through the root system. Constituents may then be transported to other parts of the plant. Mechanisms of toxicity may include inhibition of enzyme activity, interference with DNA synthesis, or blocking of uptake of essential elements. As another example, benthic invertebrates are continually exposed to constituents in sediments and pore water, and effects may include growth inhibition or impaired reproduction. The benchmarks for potential adverse effects in the current approach to ecological risk assessment, at the screening level and in the more detailed baseline analysis, are generally measured as reductions in survival, growth, or reproduction of the species.

Another potential adverse effect that may be relevant in this risk assessment is the potential for bioaccumulation. When bioaccumulation occurs, the presence of bioaccumulative constituents in environmental media may cause increases in the concentrations of those constituents in ecological receptors that are present. Constituents that are bioaccumulative typically have a high log octanol-water partition coefficient (log K_{OW}), which means that it is readily absorbed into animal tissues.

Several inorganic constituents have been detected in site media. Log K_{OW} values cannot be determined for these constituents; however, most are known not to have significant potential to bioaccumulate under typical environmental conditions. In fact, the majority of inorganic constituents are not bioaccumulative, even when present over a wide area and at high concentrations. The inorganic constituents that do have the potential to bioaccumulate in certain forms and under specific conditions include mercury and selenium.

For the SLERA, potential toxicity is evaluated through the use of benchmark concentrations for each medium. Section 4.1 presents the comparison of analytical data to the appropriate benchmark concentrations.

3.3 FATE AND TRANSPORT, ECOSYSTEMS POTENTIALLY AT RISK, AND COMPLETE EXPOSURE PATHWAYS

The following subsections provide a summary of fate and transport, ecosystems potentially at risk, and potentially complete exposure pathways that are evaluated for the site.

3.3.1 Fate and Transport

Information on how constituents will or could be transported or transformed in the environment physically, chemically, and biologically is used to identify the exposure pathways that might lead to significant ecological effects (USEPA, 1997). Chemically, contaminants can undergo several processes in the environment, including degradation, complexation, ionization, precipitation, and/or adsorption. Physically, contaminants might move through the environment by one or more means, including volatilization, erosion, deposition, weathering of parent material with subsequent transport, and/or water transport. Several biological processes also affect contaminant fate and transport in the environment: bioaccumulation, biodegradation, biological transformation, food chain transfers, and/or excretion.

While site-specific factors can affect the fate and transport of constituents through physical and chemical means, the SLERA does not quantify the majority of these processes (e.g., concentrations of VOCs in surface water or pore water are assumed to remain constant over time, although in reality they are continually decreasing as the constituents degrade in the environment).

3.3.2 Ecosystems Potentially at Risk

The ecosystems and habitats potentially at risk were identified during the ecological site reconnaissance conducted in October 2013. These are limited to the aquatic habitats associated with the East Fork of Chisholm Creek adjacent to the site. The creek is a shallow, slow-flowing stream with a channel width ranging from 10 to 20 feet. A moderate quality riparian zone of approximately 30 feet exists along the reach of the creek adjacent to the site. This riparian zone provides a vegetative buffer for the creek, as well as habitat for the adult stage of aquatic invertebrates, small mammals, birds, reptiles and amphibians.

Aquatic communities of Chisholm Creek include benthic invertebrates, crayfish, fish, amphibians, birds and small mammals. This SLERA focuses on receptor groups with the greatest potential for contact with sediments, surface water and pore water of the creek. The receptor groups that are evaluated in this SLERA consist of aquatic organisms including plants, invertebrates and fish. For this site, evaluation of higher order receptors (such as mammals and birds) is not considered to be necessary. The need for a more detailed evaluation is determined at the Scientific Management Decision Point.

3.3.3 Complete Exposure Pathways

In this section, potential exposure pathways are evaluated to determine which pathways are complete and important at the site. An exposure route is the mechanism by which a receptor species might take up a constituent. For aquatic habitats and species potentially exposed to sediments, surface water and pore water, exposure to COPEC may occur through three routes: (1) direct contact with the environmental media; (2) incidental ingestion of the environmental media; and (3) ingestion of plants or animal prey that are exposed to the environmental media.

Based on the available site information and the objectives of this SLERA, the following potentially complete and significant exposure pathways have been identified for aqutatic organisms (e.g., plants, invertebrates and fish) in Chisholm Creek: (1) direct contact with sediment; (2) direct contact with surface water; and (3) direct contact with pore water. These exposure pathways are evaluated through the identification of assessment and measurement endpoints.

3.4 ASSESSMENT ENDPOINTS

Assessment endpoints are explicit expressions of the environmental values or characteristics to be protected, and reflect societal and ecological values (USEPA, 1992, 1997). Societal values address the need to protect species that are endangered, threatened, or of special interest, important as game or commercial species, or widely recognized as having aesthetic value. Ecological relevance refers to the importance of the species to the function of the ecosystem. Therefore, evaluation of the potential for adverse effects at the population level is used to infer the potential for adverse effects at higher levels of organization such as communities and ecosystems.

Once assessment endpoints have been selected, testable hypotheses and measurement endpoints can be developed to determine whether or not a potential threat to the assessment endpoints exists.

Based on the potentially complete and significant exposure pathways identified in the previous section, the following assessment endpoints are identified for the SLERA:

1. Growth, Reproduction and Survival of Aquatic Communities: Aquatic plants, invertebrates and fish have important roles in the aquatic ecosystem. Plants provide protection and serve as a food source for many species. Invertebrate communities constitute a significant portion of the food chain in aquatic systems and are important in nutrient and energy transfer. Fish have many roles in the aquatic ecosystem, including the transfer of nutrients and energy, and as prey for mammals, birds, and predatory fish.

2. Diversity and Abundance of Benthic Invertebrates: Benthic invertebrates are important to the aquatic community as they perform numerous functions in aquatic systems. They provide essential ecosystem services by accelerating detritus decomposition and nutrient transfer.

3.5 RISK QUESTIONS AND MEASUREMENT ENDPOINTS

For each assessment endpoint listed above, risk questions are presented, and these questions are answered through the selection and use of measurement endpoints.

3.5.1 Risk Questions

USEPA (1997) guidance recommends the formation of "Risk Questions" to provide a framework for each assessment and measurement endpoint. For this reason, risk questions have been formulated for each assessment endpoint. Risk questions provide a direct approach for evaluating the specific measurement endpoints against the assessment endpoints. The measurement endpoints are evaluated to answer the risk questions. Based on the information presented in this screening level problem formulation, the following risk questions have been developed:

1. Growth, Reproduction and Survival of Aquatic Communities: Are concentrations of constituents in sediment, surface water and pore water of Chisholm Creek sufficient to cause adverse effects on the growth, reproduction and/or survival of aquatic plant, invertebrate, or fish communities?

2. Diversity and Abundance of Benthic Invertebrates: Are concentrations of constituents in sediment and pore water of Chisholm Creek sufficient to cause adverse effects on the diversity and abundance of benthic invertebrate communities, relative to reference locations?

3.5.2 Measurement Endpoints

The risk questions presented above are answered using the measurement endpoints. Measurement endpoints are quantifiable responses to stressors at a site that are related to the assessment endpoints and are intended to provide a basis for assessing the potential for risk with respect to the assessment point. There are four general types of measurement endpoints: (1) comparison of estimated or measured exposure levels of constituents to levels known to cause adverse effects; (2) bioassay testing of site and reference media; (3) in-situ toxicity testing of site and reference media; and (4) comparison of observed effects at the site with those observed at a reference site. Measurement endpoints selected for the assessment endpoint evaluation in this SLERA fall under categories (1) and (4). The following

measurement endpoints are identified for each of the assessment endpoints and their respective risk questions.

1. Growth, Reproduction and Survival of Aquatic Communities: Are concentrations of constituents in sediment, surface water and pore water of Chisholm Creek sufficient to cause adverse effects on the growth, reproduction and/or survival of aquatic plant, invertebrate, or fish communities?

To address this risk question, the following measurement endpoint is selected. (1) Analytical sediment, surface water, and pore water data from Chisholm Creek are compared to ecological benchmarks for aquatic receptors. The benchmarks represent threshold concentrations for observed adverse effects on the growth, reproduction and survival of aquatic organisms upon chronic exposure.

2. Diversity and Abundance of Benthic Invertebrates: Are concentrations of constituents in sediment and pore water of Chisholm Creek sufficient to cause adverse effects on the diversity and abundance of benthic invertebrate communities, relative to reference locations?

To address this risk question, the following measurement endpoint is selected. (1) The results of the macroinvertebrate survey are used to calculate metrics that are indicators of diversity and abundance of the invertebrate community. These results are compared to metrics for the reference location.

Significant considerations for the SLERA are the benchmark concentrations for each constituent and how exposures of ecological receptors compare with these values. For plants, invertebrates, and fish, which are constantly in contact with sediments or water, this is a consideration of ambient constituent concentration and response. For the first measurement endpoint, this information is available in peer-reviewed literature rather than in the site-specific data. For the second measurement endpoint, site-specific data are available in the form of the macroinvertebrate survey results. Visual observations and comparison with background locations are also necessary to provide additional lines of evidence in order to determine the potential for adverse effects. Further discussion of the weight-of-evidence approach is provided in Section 5.3.

4.0 CHARACTERIZATION OF POTENTIAL ECOLOGICAL EFFECTS

The next step in the SLERA is the preliminary ecological effects evaluation and the establishment of constituent exposure levels that represent conservative thresholds for adverse ecological effects. As per USEPA (1997), those conservative thresholds are called screening ecotoxicity values.

This section presents a comparison of analytical data to the screening ecotoxicity values (e.g., ecological benchmarks) in order to identify COPEC. In addition to this indirect measure of effect, the results of the macroinvertebrate survey provide a more direct measure of effects on the aquatic habitats at the site.

4.1 COMPARISON OF DATA TO ECOLOGICAL BENCHMARKS

For constituents that are associated with ecological toxicity, there is generally a threshold concentration below which adverse effects are negligible. An initial screening assessment of the potential hazard associated with site-originated constituents is made by comparing the detected concentrations to environmental benchmarks developed for ecological receptors. The evaluations for sediments, surface water, and pore water of the East Fork of Chisholm Creek are described in the following subsections.

4.1.1 Sediment Data

As discussed in Section 2.4, sediment samples were collected from eleven locations in the East Fork of Chisholm Creek, including one sample from the upstream reference location (CC-1). Table 4-1 presents a summary of the available ecological screening benchmarks for the constituents analyzed in sediment samples. The sediment benchmarks were obtained from the following hierarchy of sources:

- **Consensus-Based Sediment Quality Guidelines: Threshold Effects Concentrations (TECs)**. For this evaluation, the concentrations in sediments are compared to TECs from MacDonald et al. (2000). The TECs represent concentrations below which adverse effects to aquatic organisms are rarely expected to occur (MacDonald et al., 2000). Constituents with detected concentrations less than the TEC are not of concern for ecological receptors potentially exposed to sediments in the creek.

- **Consensus-Based Sediment Quality Guidelines as presented by the Wisconsin Department of Natural Resources (WDNR; 2003).** For constituents not presented in MacDonald et al. (2000), TECs were obtained from the WNDR's guidance document. This guidance summarizes sediment benchmarks from sources including MacDonald et al. (2000), Ontario Ministry of Environment and Energy (OMEE; Persaud et al., 1993),

and the Canadian Council of Ministers of the Environment (CCME, 1999). Constituents with detected concentrations less than the TEC are not of concern for ecological receptors potentially exposed to sediments in the creek. The TECs represent no-effects levels, similar to the values presented by MacDonald et al. (2000).

- **Region 3 Freshwater Sediment Screening Benchmarks**. For constituents not present in MacDonald et al. (2000) or WDNR (2003), the USEPA Region 3 Freshwater Sediment Screening Benchmarks (USEPA, 2008) were used for comparison. These benchmarks are considered to represent TECs.

- **USEPA Region 5 Ecological Screening Levels (ESLs)**. In the absence of screening values from the other sources listed above, the USEPA (2003) Region 5 sediment ESLs were used to screen detected constituents. The ESLs are considered to represent TECs.

- **USEPA (1999b)** – In the absence of screening values for barium from the sources listed above, the USEPA (1999b) Freshwater Sediment Toxicity Reference Value was used (20 mg/kg).

The sediment screening benchmarks described above are applied for all receptor groups (aquatic plants, invertebrates, and fish) because they are based on conservative no-adverse-effect-concentrations for the most sensitive aquatic species.

Table 4-2 presents a comparison of the sediment analytical results to ecological screening benchmarks. As shown in this table, concentrations of acenaphthene, arsenic, barium and lead exceed the TECs in one or more samples collected adjacent to the site. For acenaphthene, it should be noted that this constituent was detected in only one sample (CC-9), and the concentration of 0.033 mg/kg was "J" qualified because it was below the detection limit. Furthermore, although the detected concentration of acenaphthene exceeded the TEC of 0.0067 mg/kg, it was below the probable effects concentration (PEC) of 0.089 mg/kg (WDNR, 2003). These data support the position that acenapthene would not be associated with adverse effects in sediments of the creek. Simiarly, for arsenic, the maximum detected concentration of 13.4 mg/kg from sample CC-3 was slightly above the TEC of 9.79 mg/kg. This was the only sample with a result above the TEC, and all sample results were less than the PEC of 33 mg/kg (MacDonald et al., 2000).

The maximum detection of lead (3,320 mg/kg) was greater than its PEC (130 mg/kg; MacDonald et al., 2000) and also higher than the concentration from upstream reference sample CC-1 (12.3 mg/kg). In addition, the maximum detection of barium (236 mg/kg) was greater than the concentration from

upstream reference sample CC-1 (74.3 mg/kg). (Note that barium lacks a PEC.) For barium and lead, the sample-by-sample sediment concentrations are further reviewed in conjunction with the results of the macroinvertebrate survey (refer to Section 5).

In summary, the sediment samples collected from the East Fork of Chisholm Creek had a small number of metals and one SVOC detected at concentrations exceeding the screening benchmarks described above. All other SVOCs were either non-detect, or detected below the screening benchmark. These results suggest that there is negligible potential for adverse effects to aquatic receptors as a result of exposure to constituents in sediment from the East Fork of Chisholm Creek. Additional discussion of the analytical sediment data relative to the benthic macroinvertebrate survey is presented in Section 5.3.

4.1.2 Surface Water and Pore Water Data

Ten surface water samples collected from the East Fork of Chisholm Creek were used in the quantitative SLERA, including two samples from the upstream reference location (SW-BS-5 and SR-SW-5). In addition, eleven pore water samples were collected from the creek, including one sample from the upstream reference location (PW-1). Table 4-3 presents a summary of the available ecological screening benchmarks for each constituent analyzed in the water samples. The surface water screening benchmarks were obtained from the following hierarchy of sources:

- **KDHE Surface Water Quality Standards for Aquatic Life**. The Kansas Department of Health and the Environment (KDHE) has published acute and chronic surface water quality standards for toxic substances that are protective of aquatic life (KDHE, 2004). In this assessment, the chronic (i.e., continuous) values were conservatively used to evaluate surface water.

- **USEPA Region 3 Freshwater Screening Benchmarks**. For constituents lacking a value from KDHE (2004), the USEPA (2008) Region 3 Freshwater Screening Benchmarks were used for comparison.

It should be noted that USEPA (2013) provides National Recommended Water Quality Criteria (WQC) for several constituents in surface water. The WQC were considered for use as a secondary source of screening benchmarks; however, there were no additional values available for the constituents analyzed in surface water or pore water. Therefore, the WQC were not used as a source of benchmarks in this report.

The surface water screening benchmarks described above are applied for all receptor groups (aquatic plants, invertebrates, and fish) because they are based on conservative no-adverse-effect-concentrations for the most sensitive aquatic species.

Table 4-4 presents a comparison of the surface water results to ecological screening benchmarks. As shown in this table, the only constituent detected in surface water above the screening benchmark is 1,1,1-trichloroethane. This constituent was detected in one surface water sample (SR-SW-5) at a concentration of 21.1 ug/L, which slightly exceeds the Region 3 surface water benchmark of 11 ug/L. Sample SR-SW-5 was collected from the upstream (background) location, and none of the samples collected adjacent to the site showed detectable concentrations of 1,1,1-trichloroethane. Based on these results, there is negligible potential for adverse effects to aquatic receptors as a result of exposure to constituents in surface water from the East Fork of Chisholm Creek.

Table 4-5 presents a comparison of the pore water results to ecological screening benchmarks. As shown in this table, several constituents were detected in pore water. The maximum detected concentration for all detected constituents, however, is less than their respective screening values; therefore, there are no constituents detected in surface water which exceed the screening benchmarks. Based on these results, there is negligible potential for adverse effects to aquatic receptors as a result of exposure to constituents in pore water from the East Fork of Chisholm Creek.

4.2 MACROINVERTEBRATE SURVEY AND METRICS

A macroinvertebrate survey was conducted to provide a more direct measure of potential effects in Chisholm Creek. To assess the macroinvertebrate population, the laboratory enumerated the specimens present in each sample. The complete results for each sample, including names and counts of organisms, are presented in Appendix C, and the results are summarized in Table 4-6.

Nine benthic macroinvertebrate metrics were selected to quantify the macroinvertebrate data. The metrics were selected to represent different components of the macroinvertebrate community, including richness measures, composition measures, feeding measures, and tolerance/intolerance measures. Each metric has a calculated value, which is then assigned a score ranging from 0 to 6. The score is based on the biological condition scoring criteria provided in Figure 6.3-4 of the USEPA (1989) Rapid Bioassessment Protocol (RBP) guidance. The metric scores are summed to create a macroinvertebrate index of biotic integrity (MIBI; USEPA, 1989; Karr and Chu, 1997) for the sample. The benthic macroinvertebrate metrics are described below, along with the approach for calculating the metric values.

Total Taxa Richness: This is a measure of total species diversity and represents a count of the total number of genera or species collected in a sample. Total species diversity generally decreases as the

physical and chemical quality of a stream decreases (USEPA, 1999a). The score for this metric is based on the ratio of the site value to the reference value. Ratios greater than 80% score a 6; ratios between 60% and 80% score a 4; ratios between 40% and 60% score a 2; and ratios less than 40% score a 0.

EPT Taxa Richness: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) are generally considered to be the groups of aquatic insects most sensitive to decreases in the physical and chemical quality in a stream (USEPA, 1999a). This metric reflects the number of taxa from these three groups. The score for this metric is based on the ratio of the site value to the reference value. Ratios greater than 90% score a 6; ratios between 80% and 90% score a 4; ratios between 70% and 80% score a 2; and ratios less than 70% score a 0.

Percent EPT Specimens: This is the number of EPT specimens in the sample divided by the total number of specimens in the sample. As noted above, EPT specimens generally reflect a higher level of biotic integrity. The score for this metric is based on the ratio of the reference value to the site value. While this specific metric is not presented in Figure 6.3-4 of the USEPA (1989) RBP guidance, it is scored using the same criteria as EPT taxa richness (above). Ratios greater than 90% score a 6; ratios between 80% and 90% score a 4; ratios between 70% and 80% score a 2; and ratios less than 70% score a 0.

Jaccard Similarity Index: The Jaccard similarity index measures the degree of similarity in taxonomic composition between two samples in terms of taxon presence or absence (USEPA, 1999a). This metric compares each sample to the representative reference sample. Coefficients range from 0 to 1.0 and increase as the degree of similarity with the reference sample increases. The Jaccard similarity index is calculated as:

$$\text{Jaccard Similarity Index} = a / (a + b + c)$$

Where:

a = the number of species common to both samples

b = the number of species present in the reference sample but not in the sample being compared

c = the number of species present in the sample being compared but not in the reference sample

As the Jaccard similarity index is automatically 1 for the reference site, the values closest to 1 indicate a high level of species similarity to the reference sample. This metric is scored by multiplying the value by 6 (so that the maximum possible value is scaled in the same way as the other metrics).

Ratio of Scrapers to Filterer-Collectors. This metric reflects the riffle/run community foodbase and provides insight into the nature of potential disturbance factors. The proportion of the two feeding groups is important because predominance of a particular feeding type may indicate an unbalanced community responding to an overabundance of a particular food source (USEPA, 1989). Functional feeding categories for each species of macroinvertebrate are presented in Appendix B of the USEPA (1999a) RBP guidance and are listed in Table 4-6. Filterer-collectors (FC) are generalized feeders (meaning they have a broad range of acceptable food materials and thus are more tolerant to pollution that might alter availability of certain food), while scrapers (SC) are more specialized feeders (USEPA, 1999a). For each sample, the ratio of scrapers to filterer-collectors is calculated (e.g., number of individuals in the sample representing SC divided by the number of individuals in the sample representing FC). The score for this metric is based on the ratio of the site value to the reference value. Ratios greater than 50% score a 6; ratios between 35% and 50% score a 4; ratios between 20% and 35% score a 2; and ratios less than 20% score a 0.

Ratio of Shredders to Total: This is another metric representing feeding measures within the invertebrate community. Shredders are specialized feeders that are sensitive to riparian zone impacts and are typically well-represented in healthy streams (USEPA, 1999a). Thus, a higher percentage of shredders indicates a higher level of biotic integrity. As previously mentioned, functional feeding categories were assigned for each species of macroinvertebrate following the USEPA RBP guidance. The score for this metric is based on the ratio of the site value to the reference value. Ratios greater than 50% score a 6; ratios between 35% and 50% score a 4; ratios between 20% and 35% score a 2; and ratios less than 20% score a 0.

Modified Hilsenhoff Biotic Index (HBI): Hilsenhoff's Biotic Index (HBI) is the abundance weighted, mean tolerance value for the macroinvertebrates in a sample. Each taxa was assigned a tolerance value on a scale from 1 to 10 (refer to Appendix B of USEPA's [1999a] RBP guidance) based on their tolerance to organic constituents. A tolerance value of 10 was assigned to those species that were the most tolerant to decreases in physical and chemical quality. Taxa with tolerance values of 0 were the most intolerant to decreased physical and chemical quality. Thus, HBI is calculated as $(\Sigma\ x_i * t_i) / n$ (where x_i = number of species i, t_i = tolerance value of species i, and n = total number of specimens). The score for this metric is based on the ratio of the reference value to the site value. Ratios greater than 85% score a 6; ratios between 70% and 85% score a 4; ratios between 50% and 70% score a 2; and ratios less than 50% score a 0.

Percent Dominance of the Most Common Taxon: Percentage of the dominant taxon is a simple measure of redundancy (USEPA, 1989). A high level of redundancy is equated with the dominance of a pollution tolerant organism and a lowered diversity. For this metric, the scoring criteria evaluate actual

percent contribution, not percent comparability to the reference location (refer to Figure 6.3-4 of the USEPA [1989] RBP guidance). Percentages less than 20% score a 6; percentages between 20% and 30% score a 4; percentages between 30% and 40% score a 2; and percentages greater than 40% score a 0.

Percent Abundance of Tolerant Organisms. This is a measure of the number of invertebrates considered to be tolerant of various types of perturbation. Species with tolerance scores of 8, 9 or 10 are considered to be tolerant. The metric value is calculated as the number of tolerant specimens in the sample divided by the total number of specimens in the sample, expressed as a percent. While this specific metric is not presented in Figure 6.3-4 of the USEPA (1989) RBP guidance, it is scored in the same manner as percent dominance (above). Percentages less than 20% score a 6; percentages between 20% and 30% score a 4; percentages between 30% and 40% score a 2; and percentages greater than 40% score a 0.

The calculated metric values, and resulting scores, for each sample are presented in Table 4-7. As noted above, the metric scores have a possible range of 0 to 6, and the scores for each metric are summed to calculate the MIBI for the sample. The possible total score for the MIBI ranges from 0 to 54. The calculation of a MIBI reduces the complex macroinvertebrate assemblage data to a single number, which characterizes the overall integrity of the biological community. At the same time, the values of the individual metrics remain available and may be used to diagnose the causes of any decreases in the MIBI. Such causes can be either chemical or physical in nature (i.e., the physical nature of the habitat can affect the density of organisms present). Chemical causes can be related to the toxicological effects of industrial releases, to the effects of nutrients and organic pollution from domestic waste water treatment, or the effects of other anthropogenic influences. Physical causes can include alteration of habitats by anthropogenic disturbance, proximity to roads, buildings, and other facilities, or more widespread alteration of the watershed as a result of urban development or agriculture. Discussion and interpretation of the metric results are presented in Section 5.2.

In addition to the macroinvertebrate metrics, Habitat Assessment Field Data Sheets for low gradient streams (provided in USEPA guidance) were completed for each sampling location. The information compiled on the Habitat Assessment Data Sheets is designed to provide a measure of habitat that generally corresponds to the physical factors that affect aquatic communities. Completed Habitat Assessment Data Sheets are provided in Appendix B. The information compiled on these forms is used to assess the biological conditions of each sampling location. Discussion and interpretation of the habitat assessments are provided in Section 5.2.

5.0 SCREENING LEVEL EXPOSURE ESTIMATE AND RISK CHARACTERIZATION

The screening level exposure estimate and risk characterization comprise the last two phases of the SLERA process. The results from these steps are used to determine whether the potential for adverse ecological effects is negligible, or whether the process should continue to a more detailed ecological risk assessment.

5.1 PRELIMINARY EXPOSURE ASSESSMENT

For the SLERA, the exposure of aquatic organisms is quantified by direct comparison of the measured concentrations in the environmental media to the ecological benchmarks presented in Section 4.1. As discussed in that section, concentrations in surface water and pore water were generally below screening level benchmarks, and were determined to have neglible potential for adverse effects. In sediment, two inorganic constituents (barium and lead) were detected at concentrations above screening levels. These were evaluated in the context of the macroinvertberate results.

To provide additional information on the potential for adverse effects, the concentrations of barium and lead from each sediment sample location are compared to sediment benchmarks. Table 5-1 compares the sediment concentrations to the TECs and PECs. As shown in this table, the concentrations of barium range from 36.2 mg/kg (in sample CC-11) to 238 mg/kg (in sample CC-5), in comparison to the TEC of 20 mg/kg (a PEC is not available for barium). The results for all sample locations, including the upstream reference, exceed the TEC. The distribution of concentrations shown in Table 5-1 do not reflect a pattern suggesting that barium is related to a site-associated source.

Table 5-1 also shows that the concentrations of lead range from 5.3 mg/kg (in sample CC-11) to 3,320 mg/kg (in sample CC-8). The majority of the sample results are below the the TEC of 35.8 mg/kg. One sample (CC-5) has a lead concentration of 126 mg/kg which exceeds the TEC, but is below the PEC of 130 mg/kg. The result for sample CC-8 (3,320 mg/kg) exceeds the PEC. As with barium, the distribution of lead concentrations do not refect a pattern suggesting that this constituent is related to a site-associated source.

Additional discussion of the analytical sediment data relative to the benthic macroinvertebrate survey is presented in Section 5.3.

5.2 METRIC SCORES AND INDEX OF BIOTIC INTEGRITY

Exposure of aquatic organisms is also measured using the macroinvertebrate survey results. It should be emphasized that metrics results can be attributed to many factors, and are not necessarily based on constituent presense.

Table 5-2 summarizes the information generated from the macroinvertebrate survey for the East Fork of Chisholm Creek. For each sampling location, the following information is presented: individual metric scores, sample MIBI, percent comparison to upstream reference MIBI, biological condition category, and habitat assessment station score (from Habitat Assessment Field Data Sheets).

The total MIBIs for the five site samples ranged from 38.3 to 44.6, in comparison with the MIBI of 50 for the reference location. In accordance with USEPA's (1989) RBP guidance, an assessment of each site sample in comparison with the upstream reference sample was made. According to this guidance, samples scored at greater than 83% of the reference score are considered to be "nonimpaired". Samples scored at 54% to 79% of the reference score are considered to be "slightly impaired". Samples scored at 21% to 50% of the reference score are considered to be "moderately impaired", and samples scored at less than 17% of the reference score are considered to be "severely impaired." Values intermediate to established ranges require subjective judgment as to assessment of biological condition. In these cases, use of the habitat assessment and physiochemical data may be necessary to aid in the decision process. These classifications, combined with the information and station scores from the Habitat Assessment Field Data Sheets (Appendix B), are used to assess the biological conditions of each sampling location.

- **ECO-1A**: The MIBI for this sampling location, located 2,000 feet downstream of the site before the 21st Street bridge, was 40.2, which was 80% of the upstream reference score (50.0 at ECO-5). According to USEPA, this would be considered intermediate to the "nonimpaired" and "slightly impaired" habitat classifications. The individual metrics for ECO-1A indicated a high score for the ratio of SC to FC, which supports a high biotic integrity, although this location did have the lowest percent dominance most common taxon and percent tolerant organisms scores. This location scored favorably in comparison with the reference location for all richness and feeding measures. The habitat assessment station score was 91, which is the lowest score for samples from Chisholm Creek (the reference location had a score of 102). The lower habitat score was based largely on this location having the lowest scores for vegetative protection and riparian vegetative zone width, related to the abundance of rock fill near the bridge where the sample was collected.

- **ECO-1B**: The MIBI for this sampling location, located 750 feet downstream of the site, was 110, which was 89% of the upstream reference score (50.0 at ECO-5) and the highest of all site sampling locations. According to USEPA, this would be classified as "nonimpaired" habitat. The individual metrics for ECO-1B indicated the highest Jaccard similarity index score and percent tolerant organisms score, which both support a high biotic integrity. The habitat assessment station score was 110, the second highest of the scores for samples from Chisholm Creek (reference location had a score of 102).

- **ECO-2**: The MIBI for ECO-2, located 300 feet downstream of the site and ECO-3, was the highest of all site sampling locations at 44.6, which was 89% of the upstream reference score. According to USEPA, this would be classified as "nonimpaired" habitat. The individual metrics for ECO-2 indicated some of the highest percent dominance of most common taxon and Jaccard similarity index scores. The habitat assessment station score was 118, which was the highest of all sampling locations, including the reference location.

- **ECO-3**: The MIBI for this sampling location, located 300 feet downstream from ECO-5, was 44.0, which was 88% of the upstream reference score. This would be classified as "nonimpaired" habitat. ECO-3 had one of the highest scores for the ratio of SC to FC, but one of the lowest scores for percentage dominance of the most common taxon and Jaccard similarity index. This location scored favorably in comparison with the reference location for all richness and feeding measures. The habitat assessment station score was 98, which was comparable to the score for the reference location (102).

- **ECO-4**: The MIBI for ECO-4, the closest sampling point to the site, located 100 feet directly east of the site's boundary, roughly 300 feet downstream from ECO-5, was the lowest of all the sampling locations at 38.3, which was 77% of the upstream reference score. This would be classified as "slightly impaired" habitat. ECO-4 indicated the lowest scores for percent dominance of the most common taxon and ratio of SC to FC. The habitat assessment station score was 98, which was comparable to the score for the reference location (102).

Further discussion and interpretation of these metric results is provided in the Risk Characterization.

5.3 RISK CHARACTERIZATION

In the risk characterization step of the SLERA process, data on exposure and effects are integrated into a statement about risk to the assessment endpoints established during the problem formulation. A weight-of-evidence approach is used to interpret the results from multiple measurement endpoints (e.g., the comparison of sediment and surface water data to screening benchmarks, and the results of the invertebrate survey). A summary of the results for each of the sampling locations on the East Fork of Chisholm Creek is presented below.

- **ECO-1A**: The macroinvertebrate results for this sample, located 2,000 feet downstream of the site, indicate an invertebrate community that falls in between the range of "nonimpaired" and "slightly impaired". The sediment sample collected nearest to this location (CC-11) indicated that barium was detected at a concentration above its TEC; however, this was the case for all sediment samples (including the reference sample). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. In addition, the pore water sample (PW-11) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1A suggest that adverse effects to aquatic receptors are not associated with site-related constituents in this location.

- **ECO-1B**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-7) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-1 and SR-SW-1) and pore water sample (PW-1) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1B suggest that adverse effects to aquatic receptors are not associated with site-related constituents in this location.

- **ECO-2**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-5) indicated that barium and lead were detected at concentrations above their TECs (lead was below its PEC). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks.

The distribution of concentrations of both barium and lead do not refect a pattern suggesting that they are related to a site-associated source. The surface water samples (SW-BS-2, SR-SW-2) and pore water sample (PW-5) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-2 suggest that adverse effects to aquatic receptors are not associated with site-related constituents in this location.

- **ECO-3**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-4) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-3 and SR-SW-3) and pore water sample (PW-4) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-3 suggest that adverse effects to aquatic receptors are not associated with site-related constituents in this location.

- **ECO-4**: The macroinvertebrate results for this sample, the closest sampling point to the site, indicate "slightly impaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-3) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-4 and SR-SW-4) and pore water sample (PW-3) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-4 suggest that adverse effects to aquatic receptors are not associated with site-related constituents in this location. The "slightly impaired" macroinvertebrate community is more likely to be associated with differences in the physical habitat between ECO-4 and the upstream reference location.

- **ECO-5:** Because ECO-5 is the reference sample, it is not assigned a biological condition category. However, as evidenced by the fact that the majority of site samples fell into the "nonimpaired" category, the specific macroinvertebrate results for this sample were generally comparable to the other locations. The sediment sample collected nearest to this location (CC-5) indicated that barium was detected at a

concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The pore water sample (PW-5) collected nearest to this location also indicated that no constituents were detected above the surface water quality benchmarks. In surface water, the concentration of 1,1,1-trichloroethane from sample SR-SW-5 slightly exceeded the benchmark. However, the result from sample SW-BD-5 was non-detect. Because this location is upstream of the site, and because 1,1,1-trichloroethane was not detected above the benchmark in the other surface water or pore water samples included in this evaluation, it is not considered to be of further concern.

It may be noted that the sediment sample with the concentration of lead above the PEC (sample CC-8 with a lead concentration of 3,320 mg/kg) was not associated with a specific macroinvertebrate sample; however, it is located approximately 200 feet downstream from ECO-1B, which was identified as having "nonimpaired" habitat. The distribution of lead concentrations do not refect a pattern suggesting that this constituent is related to a site-associated source.

The current observations indicate that macroinvertebrate populations in the East Fork of Chisholm Creek adjacent to the site do not appear to be adversely affected by constituent releases from the site, nor would such an effect be expected in the future since on-site conditions should continue to improve over time. The results suggesting "slightly impaired" habitat in the vicinity of the site (e.g., ECO-4) are most likely associated with variations in habitat that were observed during the sampling procedure (e.g., this area was shallow and the channel was partially blocked by a sand bar, reducing the channel width to just a few feet for part of the reach).

5.4 UNCERTAINTY ANALYSIS

Uncertainties are inherent in a quantitative risk assessment. The inclusion of site-specific factors, which this assessment has incorporated, decreases uncertainty. An analysis of the areas of uncertainty in a risk assessment is a standard component of the risk assessment process. The uncertainty analysis provides a context for better understanding the assessment conclusions by identifying the uncertainties that have most significantly affected the assessment results. The major sources of uncertainty in this SLERA are identified qualitatively below.

Data Included in the Evaluation. The analytical data included in the SLERA consisted of sediment, surface water and pore water samples collected from approximately the same time frame (October 2013). Surface water data were available from previous semi-annual samling events; however, these samples were not included in the quantitative SLERA. The most recent set of samples is considered to provide the

most representative data set, and is consistent with the sampling that was conducted for other media (macroinvertebrates, sediment and pore water). Exclusion of earlier surface water data may result in some uncertainty in the completeness of the data set.

COPEC Screening Process. Multiple uncertainties exist in the process of identifying COPEC. Constituents detected in site media were compared with screening benchmarks that are typically based on no-observable-adverse-effects-levels, are based on chronic exposures, and are applicable to the most sensitive organisms within a category of receptors. In short, the screening benchmarks are often very conservative and not necessarily reflective of concentrations that may result in adverse effects to specific receptor species evaluated for this specific site. This approach will typically result in the identification of several COPEC although adverse effects from these constituents are not observed.

Consideration of Background Concentrations for Inorganics. In this risk assessment, comparisons of site data to regional background concentrations was not conducted. However, it is likely that some of the inorganic constituents in sediment, including barium, are present at concentrations consistent with background.

Selection of Invertebrate Metrics. A variety of metrics are available from which to select those used to evaluate invertebrate populations. For the East Fork of Chisholm Creek, the metrics were selected using USEPA guidance, and were based on the types of organisms expected to be present considering the climate and habitat type. The use of different sets of metrics could result in alternate MIBI scores.

6.0 SUMMARY AND CONCLUSIONS

This SLERA was conducted in a manner consistent with standard and customary approaches specified by the USEPA. Constituents associated with samples of sediment, surface water and pore water of the East Fork of Chisholm Creek were evaluated and included as appropriate in the assessment. Macroinvertebrate samples were also collected from the creek and were evaluated in the SLERA. The SLERA focused on habitat associated with the East Fork of Chisholm Creek adjacent to the site. Due to the industrial development of the site itself, there is insufficient habitat to warrant quantitative ecological evaluation, and exposure by terrestrial receptors on the site was considered to be de minimis.

The following potentially complete exposure pathways were identified for aqutatic organisms (e.g., plants, invertebrates and fish) in Chisholm Creek: (1) direct contact with sediment; (2) direct contact with surface water; and (3) direct contact with pore water. Specific assessment and measurement endpoints were identified to address the potentially complete exposure pathways. The assessment endpoints relate to sustainability (growth, reproduction and survival) of aquatic organisms, and to the diversity and abundance of populations of benthic invertebrates. The measurement endpoints consist of a comparison of measured concentrations of constituents to levels reported to cause adverse effects; evaluation of macroinvertebrate community metrics; and comparison of the results for site locations with the results for reference locations.

The comparison of sediment, surface water, and pore water data to ecological screening benchmarks indicated a small number of exceedances. In sediments, three inorganics (arsenic, barium, and lead) and one organic (acenaphthene) were detected at concentrations exceeding the screening benchmarks. All other constituents were either non-detect, or detected below the screening benchmark. Acenaphthene and arsenic were detected in only one sample each above their TEC, and there were no exceedances of the PEC. As such, these two constituents were determined to have neglible potential for adverse effects. For barium and lead, the sample-by-sample sediment concentrations were evaluated in the context of the results of the macroinvertebrate survey.

In surface water, only one constituent (1,1,1-trichloroethane) was detected above the surface water screening benchmark. The exceedance was detected in the upstream reference location, and none of the samples collected adjacent to the site showed detectable concentrations of 1,1,1-trichloroethane. As such, this constituent was determined to have neglible potential for adverse effects. In pore water, there were no constituents detected at concentrations above the surface water screening benchmarks.

The results of the macroinvertebrate survey indicated that, in comparison to the reference location, three of the five samples from the East Fork of Chisholm Creek suggested "nonimpaired" habitat, one sample fell in between the range of "nonimpaired" and "slightly impaired" habitat, and one sample indicated a

"slightly impaired habitat". A comparison of the analytical data to macroinvertebrate results and habitat parameters was completed to determine whether the analytical data could be correlated to the macroinvertebrate results. The results do not correlate with a conclusion that any potential impairment is site-originated. A summary of the results for each of the sampling locations on the East Fork of Chisholm Creek is presented below.

- **ECO-1A**: The macroinvertebrate results for this sample, located 2,000 feet downstream of the site, indicate an invertebrate community that falls in between the range of "nonimpaired" and "slightly impaired". The sediment sample collected nearest to this location (CC-11) indicated that barium was detected at a concentration above its TEC; however, this was the case for all sediment samples (including the reference sample). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. In addition, the pore water sample (PW-11) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1A suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-1B**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-7) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-1 and SR-SW-1) and pore water sample (PW-1) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-1B suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-2**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-5) indicated that barium and lead were detected at concentrations above their TECs (lead was below its PEC). No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The distribution of concentrations of both barium and lead do not refect a pattern suggesting that they are related to a site-associated source. The surface water samples (SW-BS-2, SR-SW-2) and pore water sample (PW-5) collected nearest to this

location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-2 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-3**: The macroinvertebrate results for this sample indicate "nonimpaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-4) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-3 and SR-SW-3) and pore water sample (PW-4) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-3 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location.

- **ECO-4**: The macroinvertebrate results for this sample, the closest sampling point to the site, indicate "slightly impaired" habitat in comparison with the upstream reference location. The sediment sample collected nearest to this location (CC-3) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The surface water samples (SW-BS-4 and SR-SW-4) and pore water sample (PW-3) collected nearest to this location indicated that no constituents were detected above the surface water quality benchmarks. The consolidated results for ECO-4 suggest that adverse effects to aqutaic receptors are not associated with site-related constituents in this location. The "slightly impaired" macroinvertebrate community is more likely to be associated with differences in the physical habitat between ECO-4 and the upstream reference location.

- **ECO-5:** Because ECO-5 is the reference sample, it is not assigned a biological condition category. However, as evidenced by the fact that the majority of site samples fell into the "nonimpaired" category, the specific macroinvertebrate results for this sample were generally comparable to the other locations. The sediment sample collected nearest to this location (CC-5) indicated that barium was detected at a concentration above its TEC; however, as stated previously, this was the case for all sediment samples. No other constituents were detected in this sediment sample at concentrations above the screening benchmarks. The pore water sample (PW-5)

collected nearest to this location also indicated that no constituents were detected above the surface water quality benchmarks. In surface water, the concentration of 1,1,1-trichloroethane from sample SR-SW-5 slightly exceeded the benchmark. However, the result from sample SW-BD-5 was non-detect. Because this location is upstream of the site, and because 1,1,1-trichloroethane was not detected above the benchmark in the other surface water or pore water samples included in this evaluation, it is not considered to be of further concern.

The current observations indicate that macroinvertebrate populations in the East Fork of Chisholm Creek adjacent to the site do not appear to be adversely affected by constituent releases from the site, nor would such an effect be expected in the future since on-site conditions should continue to improve over time. The results suggesting "slightly impaired" habitat in the vicinity of the site (e.g., ECO-4) are most likely associated with variations in habitat that were observed during the sampling procedure.

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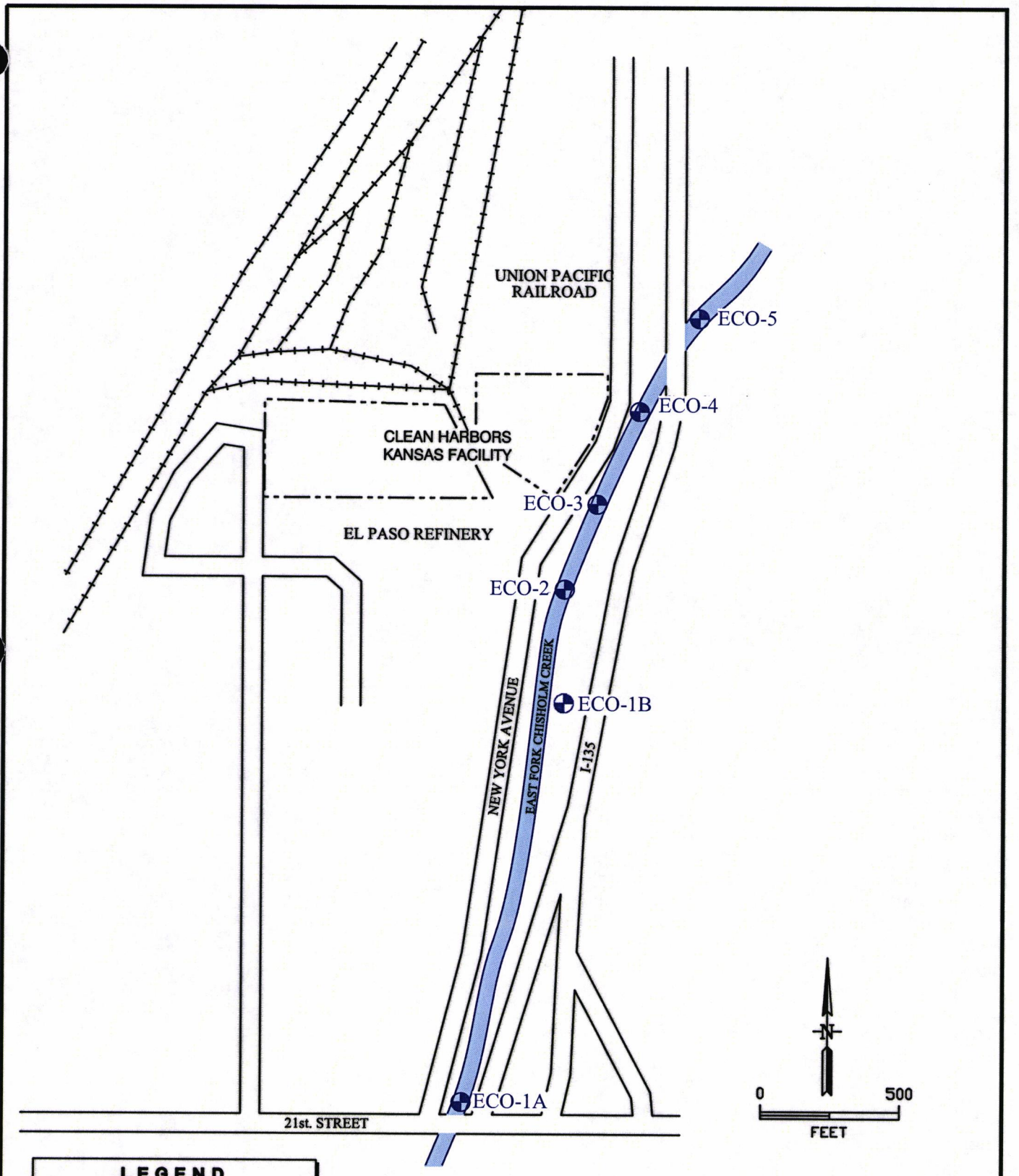
FIGURES



CAMERON-COLE

FIGURE 2-1

SURFACE WATER SAMPLING LOCATIONS
CLEAN HARBORS KANSAS, LLC

SCALE:	DATE:	DWG NO.
1" = 500'	9/8/06	1808-112

U.S. Fish and Wildlife Service

National Wetlands Inventory

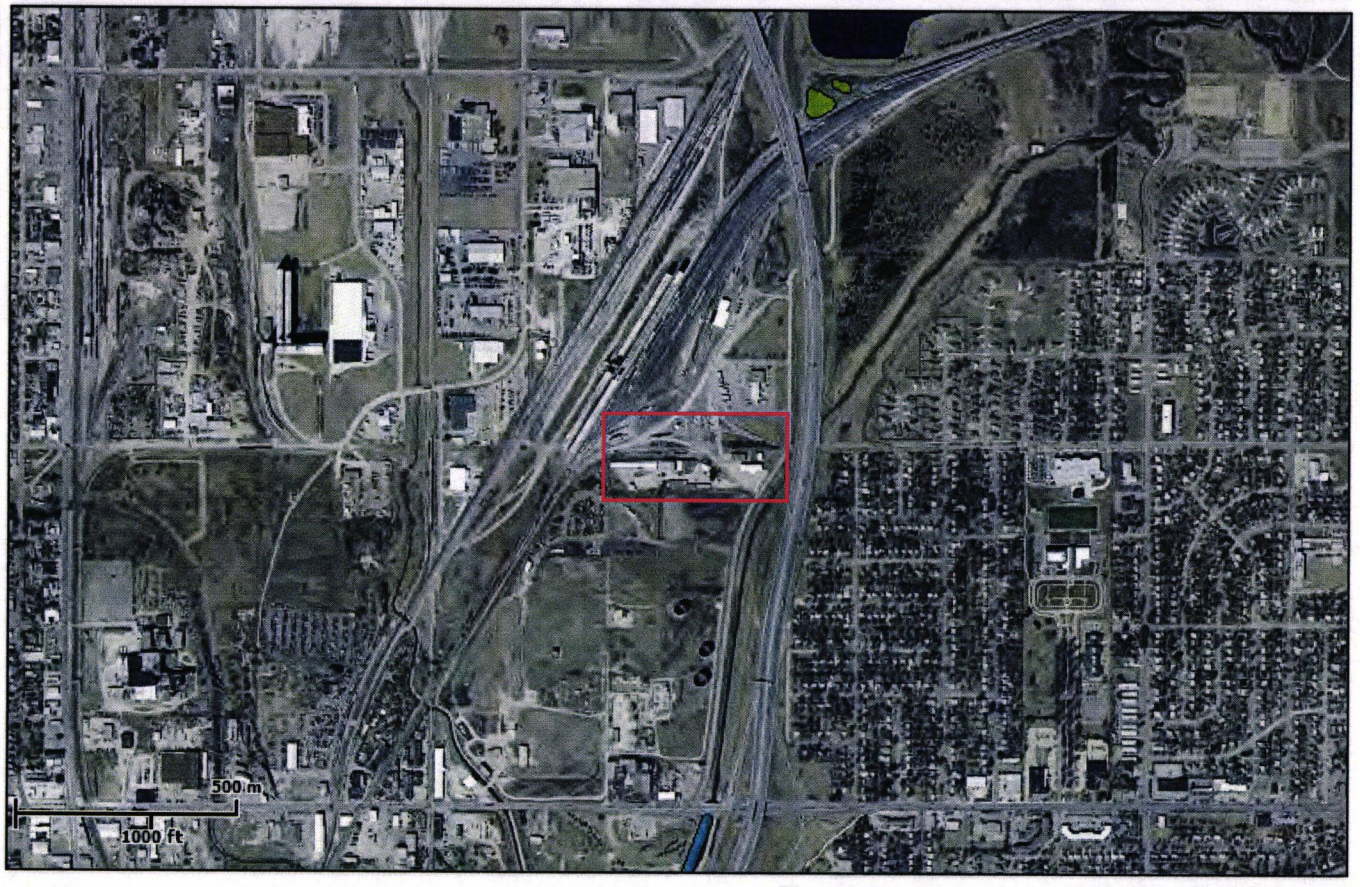


Figure 2-2: National Wetlands Inventory Map

Nov 4, 2013

Wetlands

- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

Riparian

- Herbaceous
- Forested/Shrub

- Site Location

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

User Remarks:

TABLES

TABLE 2-1
SAMPLES INCLUDED IN THE ECOLOGICAL RISK ASSESSMENT
Clean Harbors Kansas, LLC - Wichita, Kansas

Location	Description	Sample Type and Sample Number			
		Invertebrate	Surface Water	Pore Water	Sediment
East Fork of Chisholm Creek	2000 feet downstream of site before 21st Street bridge	ECO-1A	--	PW-11	CC-11
	200 feet downstream of CC-9	--	--	PW-10	CC-10
	200 feet downstream of CC-8	--	--	PW-9	CC-9
	200 feet downstream of CC-7		--	PW-8	CC-8
	750 feet downstream of site	ECO-1B	SW-BS-1, SR-SW-1	PW-7	CC-7
	80 feet downstream of ECO-2	--	--	PW-6	CC-6
	300 feet downstream of site and ECO-3; east of intersection of North New York and East 24th Street North	ECO-2	SW-BS-2, SR-SW-2	PW-5	CC-5
	300 feet downstream from ECO-4; east of intersection of North New York and East 25th Street North	ECO-3	SW-BS-3, SR-SW-3	PW-4	CC-4
	100 feet east of the site boundary; 300 feet downstream from ECO-5	ECO-4	SW-BS-4, SR-SW-4	PW-3	CC-3
	100 feet upstream from ECO-4	--	--	PW-2	CC-2
Upstream Reference	Upstream reference location; 400 feet upstream from site; only sample on eastern side of Interstate-135	ECO-5	SW-BS-5, SR-SW-5	PW-1	CC-1

TABLE 4-1
SCREENING BENCHMARKS FOR CONSTITUENTS IN SEDIMENT
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	CAS No.	Consensus-Based Threshold Effect Concentration (mg/kg)	Wisconsin Department of Natural Resources Recommended Sediment Quality Guideline Values (mg/kg)	USEPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	USEPA Region 5 Sediment Screening Benchmark (mg/kg)	Final Sediment Screening Value [1] (mg/kg)
Semi-volatile Organics						
Benzoic Acid	65850	NA	6.5	0.65	NA	6.5
2-Chlorophenol	95578	NA	NA	0.0312	0.0319	0.0312
4-Chloro-3-methyl phenol	59507	NA	NA	NA	0.388	0.388
2,4-Dichlorophenol	120832	NA	NA	0.117	0.0817	0.117
2,4-Dimethylphenol	105679	NA	0.29	0.029	0.304	0.29
2,4-Dinitrophenol	51285	NA	NA	NA	0.00621	0.00621
4,6-Dinitro-o-cresol	534521	NA	NA	NA	0.104	0.104
2-Methylphenol	95487	NA	6.7	NA	0.0554	6.7
3&4-Methylphenol	NA	NA	NA	NA	0.0202	0.0202
2-Nitrophenol	88755	NA	NA	NA	NA	NA
4-Nitrophenol	100027	NA	NA	NA	0.0133	0.0133
Pentachlorophenol	87865	NA	0.15	0.504	23	0.15
Phenol	108952	NA	4.2	0.42	0.0491	4.2
2,4,5-Trichlorophenol	95954	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	88062	NA	NA	0.213	0.208	0.213
Acenaphthene	83329	NA	0.0067	0.0067	0.00671	0.0067
Acenaphthylene	208968	NA	0.0059	0.0059	0.00587	0.0059
Aniline	62533	NA	NA	NA	0.00031	0.00031
Anthracene	120127	0.0572	0.0572	0.0572	0.0572	0.0572
Benzidine	92875	NA	NA	NA	NA	NA
Benzo(a)anthracene	56553	0.108	0.108	0.108	0.108	0.108
Benzo(a)pyrene	50328	0.15	0.15	0.15	0.15	0.15
Benzo(b)fluoranthene	205992	NA	0.24	NA	10.4	0.24
Benzo(g,h,i)perylene	191242	NA	0.17	0.17	0.17	0.17
Benzo(k)fluoranthene	207089	NA	0.24	0.24	0.24	0.24
4-Bromophenyl phenyl ether	101553	NA	NA	1.23	1.55	1.23
Butyl benzyl phthalate	85687	NA	NA	10.9	1.97	10.9
Benzyl Alcohol	100516	NA	0.57	NA	0.00104	0.57
2-Chloronaphthalene	91587	NA	NA	NA	0.417	0.417
4-Chloroaniline	106478	NA	NA	NA	0.146	0.146
Carbazole	86748	NA	NA	NA	NA	NA
Chrysene	218019	0.166	0.166	0.166	0.166	0.166
bis(2-Chloroethoxy)methane	111911	NA	NA	NA	NA	NA
bis(2-Chloroethyl)ether	111444	NA	NA	NA	3.52	3.52
bis(2-Chloroisopropyl)ether	108601	NA	NA	NA	NA	NA
4-Chlorophenyl phenyl ether	7005723	NA	NA	NA	NA	NA

TABLE 4-1
SCREENING BENCHMARKS FOR CONSTITUENTS IN SEDIMENT
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	CAS No.	Consensus-Based Threshold Effect Concentration (mg/kg)	Wisconsin Department of Natural Resources Recommended Sediment Quality Guideline Values (mg/kg)	USEPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	USEPA Region 5 Sediment Screening Benchmark (mg/kg)	Final Sediment Screening Value [1] (mg/kg)
Semi-volatile Organics (continued)						
1,2-Dichlorobenzene	95501	NA	0.023	0.0165	0.294	0.023
1,2-Diphenylhydrazine	122667	NA	NA	NA	NA	NA
1,3-Dichlorobenzene	541731	NA	NA	4.43	1.315	4.43
1,4-Dichlorobenzene	106467	NA	0.031	0.599	0.318	0.031
2,4-Dinitrotoluene	121142	NA	NA	0.0416	0.0144	0.0416
2,6-Dinitrotoluene	606202	NA	NA	NA	0.0398	0.0398
3,3'-Dichlorobenzidine	91941	NA	NA	0.127	0.127	0.127
Dibenzo(a,h)anthracene	53703	0.033	0.033	0.033	0.033	0.033
Dibenzofuran	132649	NA	0.15	0.415	0.449	0.15
Di-n-butyl phthalate	84742	NA	2.2	6.47	1.114	2.2
Di-n-octyl phthalate	117840	NA	0.58	NA	40.6	0.58
Diethyl phthalate	84662	NA	0.61	0.603	0.295	0.61
Dimethyl phthalate	131113	NA	0.53	NA	NA	0.53
bis(2-Ethylhexyl)phthalate	117817	NA	NA	0.18	0.182	0.18
Fluoranthene	206440	0.423	0.423	0.423	0.423	0.423
Fluorene	86737	0.0774	0.0774	0.0774	0.0774	0.0774
Hexachlorobenzene	118741	NA	NA	0.02	0.02	0.02
Hexachlorobutadiene	87683	NA	NA	NA	0.0265	0.0265
Hexachlorocyclopentadiene	77474	NA	NA	NA	0.901	0.901
Hexachloroethane	67721	NA	NA	1.027	0.584	1.027
Indeno(1,2,3-cd)pyrene	193395	NA	0.2	0.017	0.2	0.2
Isophorone	78591	NA	NA	NA	0.432	0.432
1-Methylnaphthalene	90120	NA	NA	NA	NA	NA
2-Methylnaphthalene	91576	NA	0.0202	0.0202	0.0202	0.0202
2-Nitroaniline	88744	NA	NA	NA	NA	NA
3-Nitroaniline	99092	NA	NA	NA	NA	NA
4-Nitroaniline	100016	NA	NA	4.06	NA	4.06
Naphthalene	91203	0.176	0.176	0.176	0.176	0.176
Nitrobenzene	98953	NA	NA	NA	0.145	0.145
N-Nitrosodimethylamine	62759	NA	NA	NA	NA	NA
N-Nitroso-di-n-propylamine	621647	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine	86306	NA	NA	2.68	NA	2.68
Phenanthrene	85018	0.204	0.204	0.204	0.204	0.204
Pyrene	129000	0.195	0.195	0.195	0.195	0.195
Pyridine	110861	NA	NA	NA	0.106	0.106
1,2,4-Trichlorobenzene	120821	NA	0.008	2.1	5.062	0.008
Toxaphene	8001352	NA	NA	0.0001	0.000077	0.0001

TABLE 4-1
SCREENING BENCHMARKS FOR CONSTITUENTS IN SEDIMENT
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	CAS No.	Consensus-Based Threshold Effect Concentration (mg/kg)	Wisconsin Department of Natural Resources Recommended Sediment Quality Guideline Values (mg/kg)	USEPA Region 3 Freshwater Sediment Screening Benchmark (mg/kg)	USEPA Region 5 Sediment Screening Benchmark (mg/kg)	Final Sediment Screening Value [1] (mg/kg)
Metals						
Arsenic	7440382	9.79	9.8	9.8	9.79	9.79
Barium [2]	7440393	NA	NA	NA	NA	20
Cadmium	7440439	0.99	0.99	0.99	0.99	0.99
Chromium	7440473	43.4	43	43.4	43.4	43.4
Lead	7439921	35.8	36	35.8	35.8	35.8
Mercury	7439976	0.18	0.18	0.18	0.174	0.18
Selenium	7782492	NA	NA	2	NA	2
Silver	7440224	NA	1.6	1	0.5	1.6
General Chemistry						
Percent Solids (%)	NA	NA	NA	NA	NA	NA
Total Organic Carbon (mg/kg)	NA	NA	NA	NA	NA	NA

Notes:
NA - Not Available
[1] Final screening value is selected according to the hierarchy described in the text.
[2] The screening value for barium is based on the USEPA (1999b) Freshwater Sediment TRV.

TABLE 4-2
COMPARISON OF SEDIMENT DATA FROM CHISHOLM CREEK TO SEDIMENT BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (mg/kg)	Maximum Detected Soil Concentration (mg/kg)	Sample with Maximum Detect	Minimum Detection Limit (mg/kg)	Maximum Detection Limit (mg/kg)	Final Sediment Screening Benchmark (mg/kg)	Constituent of Potential Ecological Concern	Comment
Semi-volatile Organics									
Benzoic Acid	0 / 11	ND	ND	ND	0.97	1.1	6.5	No	Constituent not detected.
2-Chlorophenol	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0312	No	Constituent not detected.
4-Chloro-3-methyl phenol	0 / 11	ND	ND	ND	0.19	0.23	0.388	No	Constituent not detected.
2,4-Dichlorophenol	0 / 11	ND	ND	ND	0.19	**0.23**	0.117	No	Constituent not detected.
2,4-Dimethylphenol	0 / 11	ND	ND	ND	0.19	0.23	0.29	No	Constituent not detected.
2,4-Dinitrophenol	0 / 11	ND	ND	ND	**0.97**	**1.1**	0.00621	No	Constituent not detected.
4,6-Dinitro-o-cresol	0 / 11	ND	ND	ND	**0.39**	**0.46**	0.104	No	Constituent not detected.
2-Methylphenol	0 / 11	ND	ND	ND	0.19	0.23	6.7	No	Constituent not detected.
3&4-Methylphenol	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0202	No	Constituent not detected.
2-Nitrophenol	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
4-Nitrophenol	0 / 11	ND	ND	ND	**0.97**	**1.1**	0.0133	No	Constituent not detected.
Pentachlorophenol	0 / 11	ND	ND	ND	**0.97**	**1.1**	0.15	No	Constituent not detected.
Phenol	0 / 11	ND	ND	ND	0.19	0.23	4.2	No	Constituent not detected.
2,4,5-Trichlorophenol	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
2,4,6-Trichlorophenol	0 / 11	ND	ND	ND	0.19	**0.23**	0.213	No	Constituent not detected.
Acenaphthene	1 / 11	0.033	0.033	CC-9	**0.19**	**0.23**	0.0067	**YES**	Maximum detect exceeds screening value.
Acenaphthylene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0059	No	Constituent not detected.
Aniline	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.00031	No	Constituent not detected.
Anthracene	1 / 11	0.0264	0.0264	CC-9	**0.19**	**0.23**	0.0572	No	Maximum detect below screening value.
Benzidine	0 / 11	ND	ND	ND	1.9	2.3	NA	No	Constituent not detected.
Benzo(a)anthracene	1 / 11	0.032	0.032	CC-10	**0.19**	**0.21**	0.108	No	Maximum detect below screening value.
Benzo(a)pyrene	2 / 11	0.0368	0.0611	CC-2	**0.19**	**0.21**	0.15	No	Maximum detect below screening value.
Benzo(b)fluoranthene	2 / 11	0.0659	0.0679	CC-2	0.19	0.21	0.24	No	Maximum detect below screening value.
Benzo(g,h,i)perylene	2 / 11	0.0652	0.089	CC-2	**0.19**	**0.21**	0.17	No	Maximum detect below screening value.
Benzo(k)fluoranthene	1 / 11	0.0296	0.0296	CC-10	0.19	0.21	0.24	No	Maximum detect below screening value.
4-Bromophenyl phenyl ether	0 / 11	ND	ND	ND	0.19	0.23	1.23	No	Constituent not detected.
Butyl benzyl phthalate	0 / 11	ND	ND	ND	0.19	0.23	10.9	No	Constituent not detected.
Benzyl Alcohol	0 / 11	ND	ND	ND	0.19	0.23	0.57	No	Constituent not detected.
2-Chloronaphthalene	0 / 11	ND	ND	ND	0.19	0.23	0.417	No	Constituent not detected.
4-Chloroaniline	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.146	No	Constituent not detected.
Carbazole	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
Chrysene	2 / 11	0.0501	0.0622	CC-10	**0.19**	**0.21**	0.166	No	Maximum detect below screening value.
bis(2-Chloroethoxy)methane	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
bis(2-Chloroethyl)ether	0 / 11	ND	ND	ND	0.19	0.23	3.52	No	Constituent not detected.

TABLE 4-2
COMPARISON OF SEDIMENT DATA FROM CHISHOLM CREEK TO SEDIMENT BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (mg/kg)	Maximum Detected Soil Concentration (mg/kg)	Sample with Maximum Detect	Minimum Detection Limit (mg/kg)	Maximum Detection Limit (mg/kg)	Final Sediment Screening Benchmark (mg/kg)	Constituent of Potential Ecological Concern	Comment
Semi-volatile Organics (continued)									
bis(2-Chloroisopropyl)ether	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
4-Chlorophenyl phenyl ether	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
1,2-Dichlorobenzene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.023	No	Constituent not detected.
1,2-Diphenylhydrazine	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
1,3-Dichlorobenzene	0 / 11	ND	ND	ND	0.19	0.23	4.43	No	Constituent not detected.
1,4-Dichlorobenzene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.031	No	Constituent not detected.
2,4-Dinitrotoluene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0416	No	Constituent not detected.
2,6-Dinitrotoluene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0398	No	Constituent not detected.
3,3'-Dichlorobenzidine	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.127	No	Constituent not detected.
Dibenzo(a,h)anthracene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.033	No	Constituent not detected.
Dibenzofuran	1 / 11	0.0246	0.0246	CC-9	**0.19**	**0.23**	0.15	No	Maximum detect below screening value.
Di-n-butyl phthalate	0 / 11	ND	ND	ND	0.39	0.46	2.2	No	Constituent not detected.
Di-n-octyl phthalate	0 / 11	ND	ND	ND	0.19	0.23	0.58	No	Constituent not detected.
Diethyl phthalate	0 / 11	ND	ND	ND	0.39	0.46	0.61	No	Constituent not detected.
Dimethyl phthalate	0 / 11	ND	ND	ND	0.19	0.23	0.53	No	Constituent not detected.
bis(2-Ethylhexyl)phthalate	0 / 11	ND	ND	ND	0.39	**0.46**	0.18	No	Constituent not detected.
Fluoranthene	2 / 11	0.0224	0.0654	CC-10	0.19	0.21	0.423	No	Maximum detect below screening value.
Fluorene	1 / 11	0.0606	0.0606	CC-9	**0.19**	**0.23**	0.0774	No	Maximum detect below screening value.
Hexachlorobenzene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.02	No	Constituent not detected.
Hexachlorobutadiene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0265	No	Constituent not detected.
Hexachlorocyclopentadiene	0 / 11	ND	ND	ND	0.19	0.23	0.901	No	Constituent not detected.
Hexachloroethane	0 / 11	ND	ND	ND	0.19	0.23	1.027	No	Constituent not detected.
Indeno(1,2,3-cd)pyrene	1 / 11	0.0409	0.0409	CC-10	0.19	**0.21**	0.2	No	Maximum detect below screening value.
Isophorone	0 / 11	ND	ND	ND	0.19	0.23	0.432	No	Constituent not detected.
1-Methylnaphthalene	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
2-Methylnaphthalene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.0202	No	Constituent not detected.
2-Nitroaniline	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
3-Nitroaniline	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
4-Nitroaniline	0 / 11	ND	ND	ND	0.19	0.23	4.06	No	Constituent not detected.
Naphthalene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.176	No	Constituent not detected.
Nitrobenzene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.145	No	Constituent not detected.
N-Nitrosodimethylamine	0 / 11	ND	ND	ND	0.39	0.46	NA	No	Constituent not detected.
N-Nitroso-di-n-propylamine	0 / 11	ND	ND	ND	0.19	0.23	NA	No	Constituent not detected.
N-Nitrosodiphenylamine	0 / 11	ND	ND	ND	0.19	0.23	2.68	No	Constituent not detected.

TABLE 4-2
COMPARISON OF SEDIMENT DATA FROM CHISHOLM CREEK TO SEDIMENT BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (mg/kg)	Maximum Detected Soil Concentration (mg/kg)	Sample with Maximum Detect	Minimum Detection Limit (mg/kg)	Maximum Detection Limit (mg/kg)	Final Sediment Screening Benchmark (mg/kg)	Constituent of Potential Ecological Concern	Comment
Semi-volatile Organics (continued)									
Phenanthrene	1 / 11	0.0269	0.0269	CC-10	0.19	**0.21**	0.204	No	Maximum detect below screening value.
Pyrene	3 / 11	0.0235	0.0572	CC-10	**0.19**	**0.21**	0.195	No	Maximum detect below screening value.
Pyridine	0 / 11	ND	ND	ND	**0.39**	**0.46**	0.106	No	Constituent not detected.
1,2,4-Trichlorobenzene	0 / 11	ND	ND	ND	**0.19**	**0.23**	0.008	No	Constituent not detected.
Toxaphene	0 / 11	ND	ND	ND	**0.097**	**0.11**	0.0001	No	Constituent not detected.
Metals									
Arsenic	11 / 11	2.3	13.4	CC-3	- -	- -	9.79	**YES**	Maximum detect exceeds screening value.
Barium	11 / 11	36.2	238	CC-5	- -	- -	20	**YES**	Maximum detect exceeds screening value.
Cadmium	1 / 11	0.35	0.35	CC-8	0.18	0.84	0.99	No	Maximum detect below screening value.
Chromium	11 / 11	2	11	CC-10	- -	- -	43.4	No	Maximum detect below screening value.
Lead	11 / 11	5.3	3320	CC-8	- -	- -	35.8	**YES**	Maximum detect exceeds screening value.
Mercury	0 / 11	ND	ND	ND	0.043	0.051	0.18	No	Constituent not detected.
Selenium	0 / 11	ND	ND	ND	0.89	**4.2**	2	No	Constituent not detected.
Silver	0 / 11	ND	ND	ND	0.39	0.9	1.6	No	Constituent not detected.
General Chemistry									
Percent Solids (%)	11 / 11	73.5	85.8	CC-7	- -	- -	NA	No	Physical property.
Total Organic Carbon (mg/kg)	9 / 11	2040	12300	CC-10	1200	1200	NA	No	Physical property.

Notes:
Values in bold indicate detection limit exceeds screening level.
"- -" Constituent detected in every sample; detection limit not presented.
NA- Not Available
ND- Not Detected

TABLE 4-3
SCREENING BENCHMARKS FOR CONSTITUENTS IN SURFACE WATER AND PORE WATER
Former Hercules Incorporated Higgins Plant - Gibbstown, New Jersey

Constituent	CAS #	KDHE Surface Water Quality Standards for Aquatic Life - Chronic (ug/L)	USEPA National Recommended WQC - Chronic (ug/L)	USEPA Region 3 Freshwater Screening Benchmark (ug/L)	Final Surface Water Screening Value[1] (ug/L)
Volatile Organics					
Acetone	67641	NA	NA	1500	1500
Acrolein	107028	21	3	NA	21
Acrylonitrile	107131	2600	NA	NA	2600
Benzene	71432	NA	NA	370	370
Bromobenzene	108861	NA	NA	NA	NA
Bromochloromethane	74975	NA	NA	NA	NA
Bromodichloromethane	75274	NA	NA	NA	NA
Bromoform	75252	NA	NA	320	320
n-Butylbenzene	104518	NA	NA	NA	NA
sec-Butylbenzene	135988	NA	NA	NA	NA
tert-Butylbenzene	98066	NA	NA	NA	NA
Chlorobenzene	108907	NA	NA	1.3	1.3
Chloroethane	75003	NA	NA	NA	NA
Chloroform	67663	1240	NA	1.8	1240
o-Chlorotoluene	95498	NA	NA	NA	NA
p-Chlorotoluene	106434	NA	NA	NA	NA
2-Chloroethyl vinyl ether	110758	NA	NA	NA	NA
Carbon disulfide	75150	NA	NA	0.92	0.92
Carbon tetrachloride	56235	NA	NA	13.3	13.3
1,1-Dichloroethane	75343	NA	NA	47	47
1,1-Dichloroethylene	75354	NA	NA	25	25
1,1-Dichloropropene	563586	NA	NA	NA	NA
1,2-Dibromo-3-chloropropane	96128	NA	NA	NA	NA
1,2-Dibromoethane	106934	NA	NA	NA	NA
1,2-Dichloroethane	107062	2000	NA	100	2000
1,2-Dichloropropane	78875	5700	NA	NA	5700
1,3-Dichloropropane	142289	244	NA	NA	244
1,4-Dioxane	123911	NA	NA	NA	NA
2,2-Dichloropropane	594207	NA	NA	NA	NA
Dibromochloromethane	124481	NA	NA	NA	NA
Dichlorodifluoromethane	75718	NA	NA	NA	NA
cis-1,2-Dichloroethylene	156592	NA	NA	590	590
cis-1,3-Dichloropropene	10061015	NA	NA	0.055	0.055
m-Dichlorobenzene	541731	763	NA	150	763
o-Dichlorobenzene	95501	763	NA	0.7	763

TABLE 4-3
SCREENING BENCHMARKS FOR CONSTITUENTS IN SURFACE WATER AND PORE WATER
Former Hercules Incorporated Higgins Plant - Gibbstown, New Jersey

Constituent	CAS #	KDHE Surface Water Quality Standards for Aquatic Life - Chronic (ug/L)	USEPA National Recommended WQC - Chronic (ug/L)	USEPA Region 3 Freshwater Screening Benchmark (ug/L)	Final Surface Water Screening Value[1] (ug/L)
Volatile Organics (continued)					
p-Dichlorobenzene	106467	NA	NA	26	26
trans-1,2-Dichloroethylene	156605	NA	NA	970	970
trans-1,3-Dichloropropene	10061026	NA	NA	NA	NA
Ethylbenzene	100414	NA	NA	90	90
2-Hexanone	591786	NA	NA	99	99
Hexachlorobutadiene	87683	9.3	NA	1.3	9.3
Isopropylbenzene	98828	NA	NA	2.6	2.6
p-Isopropyltoluene	99876	NA	NA	85	85
4-Methyl-2-pentanone	108101	NA	NA	170	170
Methyl bromide	74839	NA	NA	NA	NA
Methyl chloride	74873	NA	NA	NA	NA
Methylene bromide	74953	NA	NA	NA	NA
Methylene chloride	75092	NA	NA	98.1	98.1
Methyl ethyl ketone	78933	NA	NA	14000	14000
Methyl Tert Butyl Ether	1634044	NA	NA	11070	11070
Naphthalene	91203	620	NA	1.1	620
n-Propylbenzene	103651	NA	NA	128	128
Styrene	100425	NA	NA	72	72
1,1,1,2-Tetrachloroethane	630206	NA	NA	NA	NA
1,1,1-Trichloroethane	71556	NA	NA	11	11
1,1,2,2-Tetrachloroethane	79345	2400	NA	610	2400
1,1,2-Trichloroethane	79005	9400	NA	1200	9400
1,2,3-Trichlorobenzene	87616	NA	NA	8	8
1,2,3-Trichloropropane	96184	NA	NA	NA	NA
1,2,4-Trichlorobenzene	120821	250	NA	24	250
1,2,4-Trimethylbenzene	95636	NA	NA	33	33
1,3,5-Trimethylbenzene	108678	NA	NA	71	71
Tetrachloroethylene	127184	840	NA	111	840
Toluene	108883	NA	NA	2	2
Trichloroethylene	79016	21900	NA	21	21900
Trichlorofluoromethane	75694	NA	NA	NA	NA
Vinyl chloride	75014	NA	NA	930	930
Vinyl Acetate	108054	NA	NA	16	16
m,p-Xylene	NA	NA	NA	1.8	1.8
o-Xylene	95476	NA	NA	1.8	1.8

TABLE 4-3
SCREENING BENCHMARKS FOR CONSTITUENTS IN SURFACE WATER AND PORE WATER
Former Hercules Incorporated Higgins Plant - Gibbstown, New Jersey

Constituent	CAS #	KDHE Surface Water Quality Standards for Aquatic Life - Chronic (ug/L)	USEPA National Recommended WQC - Chronic (ug/L)	USEPA Region 3 Freshwater Screening Benchmark (ug/L)	Final Surface Water Screening Value[1] (ug/L)
Semi-volatile Organics					
Toxaphene	8001352	0.0002	0.0002	0.0002	0.0002

Notes:
NA - Not Available
[1] Final screening value is selected according to the hierarchy described in the text.

TABLE 4-4
COMPARISON OF SURFACE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics									
Acetone	0 / 10	ND	ND	ND	25	130	1500	No	Constituent not detected.
Acrolein	0 / 10	ND	ND	ND	20	**100**	21	No	Constituent not detected.
Acrylonitrile	0 / 10	ND	ND	ND	10	50	2600	No	Constituent not detected.
Benzene	1 / 10	2.2	2.2	SR-SW-1	1	5	370	No	Maximum detect below screening value.
Bromobenzene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Bromochloromethane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Bromodichloromethane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Bromoform	0 / 10	ND	ND	ND	1	5	320	No	Constituent not detected.
n-Butylbenzene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
sec-Butylbenzene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
tert-Butylbenzene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Chlorobenzene	0 / 10	ND	ND	ND	1	**5**	1.3	No	Constituent not detected.
Chloroethane	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
Chloroform	0 / 10	ND	ND	ND	1	5	1240	No	Constituent not detected.
o-Chlorotoluene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
p-Chlorotoluene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
2-Chloroethyl vinyl ether	0 / 10	ND	ND	ND	5	25	NA	No	Constituent not detected.
Carbon disulfide	0 / 10	ND	ND	ND	**2**	**10**	0.92	No	Constituent not detected.
Carbon tetrachloride	0 / 10	ND	ND	ND	1	5	13.3	No	Constituent not detected.
1,1-Dichloroethane	1 / 10	5.8	5.8	SR-SW-5	1	1	47	No	Maximum detect below screening value.
1,1-Dichloroethylene	1 / 10	2.2	2.2	SR-SW-5	1	1	25	No	Maximum detect below screening value.
1,1-Dichloropropene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
1,2-Dibromo-3-chloropropane	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
1,2-Dibromoethane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
1,2-Dichloroethane	0 / 10	ND	ND	ND	1	5	2000	No	Constituent not detected.
1,2-Dichloropropane	0 / 10	ND	ND	ND	1	5	5700	No	Constituent not detected.
1,3-Dichloropropane	0 / 10	ND	ND	ND	1	5	244	No	Constituent not detected.
1,4-Dioxane	0 / 10	ND	ND	ND	200	1000	NA	No	Constituent not detected.
2,2-Dichloropropane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Dibromochloromethane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Dichlorodifluoromethane	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.

TABLE 4-4
COMPARISON OF SURFACE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics (continued)									
cis-1,2-Dichloroethylene	4 / 10	0.52	145.4125	SR-SW-5	1	1	590	No	Maximum detect below screening value.
cis-1,3-Dichloropropene	0 / 10	ND	ND	ND	**1**	**5**	0.055	No	Constituent not detected.
m-Dichlorobenzene	0 / 10	ND	ND	ND	1	5	763	No	Constituent not detected.
o-Dichlorobenzene	0 / 10	ND	ND	ND	1	5	763	No	Constituent not detected.
p-Dichlorobenzene	0 / 10	ND	ND	ND	1	5	26	No	Constituent not detected.
trans-1,2-Dichloroethylene	1 / 10	1.7	1.7	SR-SW-5	1	1	970	No	Maximum detect below screening value.
trans-1,3-Dichloropropene	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
Ethylbenzene	1 / 10	0.32	0.32	SR-SW-1	1	5	90	No	Maximum detect below screening value.
2-Hexanone	0 / 10	ND	ND	ND	10	50	99	No	Constituent not detected.
Hexachlorobutadiene	0 / 10	ND	ND	ND	**2**	**10**	9.3	No	Constituent not detected.
Isopropylbenzene	0 / 10	ND	ND	ND	**1**	**5**	2.6	No	Constituent not detected.
p-Isopropyltoluene	0 / 10	ND	ND	ND	1	5	85	No	Constituent not detected.
4-Methyl-2-pentanone	0 / 10	ND	ND	ND	5	25	170	No	Constituent not detected.
Methyl bromide	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
Methyl chloride	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
Methylene bromide	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
Methylene chloride	1 / 10	8.6	8.6	SR-SW-5	5	5	98.1	No	Maximum detect below screening value.
Methyl ethyl ketone	0 / 10	ND	ND	ND	5	25	14000	No	Constituent not detected.
Methyl Tert Butyl Ether	0 / 10	ND	ND	ND	1	5	11070	No	Constituent not detected.
Naphthalene	0 / 10	ND	ND	ND	3	15	620	No	Constituent not detected.
n-Propylbenzene	0 / 10	ND	ND	ND	1	5	128	No	Constituent not detected.
Styrene	0 / 10	ND	ND	ND	1	5	72	No	Constituent not detected.
1,1,1,2-Tetrachloroethane	0 / 10	ND	ND	ND	1	5	NA	No	Constituent not detected.
1,1,1-Trichloroethane	1 / 10	21.1	21.1	SR-SW-5	1	1	11	**YES**	Maximum detect exceeds screening value.
1,1,2,2-Tetrachloroethane	0 / 10	ND	ND	ND	1	5	2400	No	Constituent not detected.
1,1,2-Trichloroethane	0 / 10	ND	ND	ND	1	5	9400	No	Constituent not detected.
1,2,3-Trichlorobenzene	0 / 10	ND	ND	ND	1	5	8	No	Constituent not detected.
1,2,3-Trichloropropane	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
1,2,4-Trichlorobenzene	0 / 10	ND	ND	ND	1	5	250	No	Constituent not detected.
1,2,4-Trimethylbenzene	0 / 10	ND	ND	ND	2	10	33	No	Constituent not detected.
1,3,5-Trimethylbenzene	0 / 10	ND	ND	ND	2	10	71	No	Constituent not detected.

TABLE 4-4
COMPARISON OF SURFACE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics (continued)									
Tetrachloroethylene	1 / 10	214.05	214.05	SR-SW-5	1	1	840	No	Maximum detect below screening value.
Toluene	0 / 10	ND	ND	ND	1	**5**	2	No	Constituent not detected.
Trichloroethylene	9 / 10	0.47	101.425	SR-SW-5	1	1	21900	No	Maximum detect below screening value.
Trichlorofluoromethane	0 / 10	ND	ND	ND	2	10	NA	No	Constituent not detected.
Vinyl chloride	0 / 10	ND	ND	ND	1	5	930	No	Constituent not detected.
Vinyl Acetate	0 / 10	ND	ND	ND	10	**50**	16	No	Constituent not detected.
m,p-Xylene	0 / 10	ND	ND	ND	**2**	**10**	1.8	No	Constituent not detected.
o-Xylene	0 / 10	ND	ND	ND	1	**5**	1.8	No	Constituent not detected.

Notes:
Values in bold indicate detection limit exceeds screening level.
NA- Not Available
ND- Not Detected

TABLE 4-5
COMPARISON OF PORE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics									
Acetone	1 / 11	17.3	17.3	PW-7	25	25	1500	No	Maximum detect below screening value.
Acrolein	0 / 11	ND	ND	ND	20	20	21	No	Constituent not detected.
Acrylonitrile	0 / 11	ND	ND	ND	10	10	2600	No	Constituent not detected.
Benzene	5 / 11	0.43	11.1	PW-7	1	1	370	No	Maximum detect below screening value.
Bromobenzene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Bromochloromethane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Bromodichloromethane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Bromoform	0 / 11	ND	ND	ND	1	1	320	No	Constituent not detected.
n-Butylbenzene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
sec-Butylbenzene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
tert-Butylbenzene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Chlorobenzene	0 / 11	ND	ND	ND	1	1	1.3	No	Constituent not detected.
Chloroethane	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
Chloroform	0 / 11	ND	ND	ND	1	1	1240	No	Constituent not detected.
o-Chlorotoluene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
p-Chlorotoluene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
2-Chloroethyl vinyl ether	0 / 11	ND	ND	ND	5	5	NA	No	Constituent not detected.
Carbon disulfide	0 / 11	ND	ND	ND	**2**	**2**	0.92	No	Constituent not detected.
Carbon tetrachloride	0 / 11	ND	ND	ND	1	1	13.3	No	Constituent not detected.
1,1-Dichloroethane	6 / 11	0.23	15.3	PW-3	1	1	47	No	Maximum detect below screening value.
1,1-Dichloroethylene	1 / 11	0.85	0.85	PW-3	1	1	25	No	Maximum detect below screening value.
1,1-Dichloropropene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
1,2-Dibromo-3-chloropropane	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
1,2-Dibromoethane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
1,2-Dichloroethane	0 / 11	ND	ND	ND	1	1	2000	No	Constituent not detected.
1,2-Dichloropropane	0 / 11	ND	ND	ND	1	1	5700	No	Constituent not detected.
1,3-Dichloropropane	0 / 11	ND	ND	ND	1	1	244	No	Constituent not detected.
1,4-Dioxane	0 / 11	ND	ND	ND	200	200	NA	No	Constituent not detected.
2,2-Dichloropropane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Dibromochloromethane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Dichlorodifluoromethane	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.

TABLE 4-5
COMPARISON OF PORE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics (continued)									
cis-1,2-Dichloroethylene	10 / 11	0.27	20.1	PW-6	1	1	590	No	Maximum detect below screening value.
cis-1,3-Dichloropropene	0 / 11	ND	ND	ND	1	1	0.055	No	Constituent not detected.
m-Dichlorobenzene	0 / 11	ND	ND	ND	1	1	763	No	Constituent not detected.
o-Dichlorobenzene	0 / 11	ND	ND	ND	1	1	763	No	Constituent not detected.
p-Dichlorobenzene	0 / 11	ND	ND	ND	1	1	26	No	Constituent not detected.
trans-1,2-Dichloroethylene	1 / 11	0.25	0.25	PW-5	1	1	970	No	Maximum detect below screening value.
trans-1,3-Dichloropropene	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
Ethylbenzene	3 / 11	0.34	0.6	PW-8	1	1	90	No	Maximum detect below screening value.
2-Hexanone	0 / 11	ND	ND	ND	10	10	99	No	Constituent not detected.
Hexachlorobutadiene	0 / 11	ND	ND	ND	2	2	9.3	No	Constituent not detected.
Isopropylbenzene	1 / 11	1.9	1.9	PW-7	1	1	2.6	No	Maximum detect below screening value.
p-Isopropyltoluene	0 / 11	ND	ND	ND	1	1	85	No	Constituent not detected.
4-Methyl-2-pentanone	0 / 11	ND	ND	ND	5	5	170	No	Constituent not detected.
Methyl bromide	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
Methyl chloride	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
Methylene bromide	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
Methylene chloride	0 / 11	ND	ND	ND	5	5	98.1	No	Constituent not detected.
Methyl ethyl ketone	1 / 11	6.1	6.1	PW-7	5	5	14000	No	Maximum detect below screening value.
Methyl Tert Butyl Ether	5 / 11	0.22	15.4	PW-7	1	1	11070	No	Maximum detect below screening value.
Naphthalene	0 / 11	ND	ND	ND	3	3	620	No	Constituent not detected.
n-Propylbenzene	1 / 11	0.41	0.41	PW-9	1	1	128	No	Maximum detect below screening value.
Styrene	0 / 11	ND	ND	ND	1	1	72	No	Constituent not detected.
1,1,1,2-Tetrachloroethane	0 / 11	ND	ND	ND	1	1	NA	No	Constituent not detected.
1,1,1-Trichloroethane	2 / 11	0.25	6	PW-3	1	1	11	No	Maximum detect below screening value.
1,1,2,2-Tetrachloroethane	0 / 11	ND	ND	ND	1	1	2400	No	Constituent not detected.
1,1,2-Trichloroethane	0 / 11	ND	ND	ND	1	1	9400	No	Constituent not detected.
1,2,3-Trichlorobenzene	0 / 11	ND	ND	ND	1	1	8	No	Constituent not detected.
1,2,3-Trichloropropane	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
1,2,4-Trichlorobenzene	0 / 11	ND	ND	ND	1	1	250	No	Constituent not detected.
1,2,4-Trimethylbenzene	2 / 11	0.23	0.29	PW-8	2	2	33	No	Maximum detect below screening value.
1,3,5-Trimethylbenzene	0 / 11	ND	ND	ND	2	2	71	No	Constituent not detected.

TABLE 4-5
COMPARISON OF PORE WATER DATA FROM CHISHOLM CREEK TO SURFACE WATER BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Constituent	Frequency of Detection	Minimum Detected Soil Concentration (µg/L)	Maximum Detected Soil Concentration (µg/L)	Sample with Maximum Detect	Minimum Detection Limit (µg/L)	Maximum Detection Limit (µg/L)	Ecological Surface Water Screening Value (ug/L)	Constituent of Potential Ecological Concern	Comment
Volatile Organics (continued)									
Tetrachloroethylene	5 / 11	0.4	3.3	PW-6	1	1	840	No	Maximum detect below screening value.
Toluene	2 / 11	0.52	0.76	PW-10	1	1	2	No	Maximum detect below screening value.
Trichloroethylene	9 / 11	2.1	70.3	PW-6	1	1	21900	No	Maximum detect below screening value.
Trichlorofluoromethane	0 / 11	ND	ND	ND	2	2	NA	No	Constituent not detected.
Vinyl chloride	2 / 11	0.44	0.44	PW-6	1	1	930	No	Maximum detect below screening value.
Vinyl Acetate	0 / 11	ND	ND	ND	10	10	16	No	Constituent not detected.
m,p-Xylene	3 / 11	0.46	0.63	PW-7	2	**2**	1.8	No	Maximum detect below screening value.
o-Xylene	1 / 11	0.2	0.2	PW-10	1	1	1.8	No	Maximum detect below screening value.
Semi-volatile Organics									
Toxaphene	0 / 11	ND	ND	ND	**2.4**	**2.5**	0.0002	No	Constituent not detected.

Notes:
NA- Not Available
ND- Not Detected

TABLE 4-6
BENTHIC MACROINVERTEBRATE DATA, COUNTS, AND STATISTICS - CHISHOLM CREEK
Clean Harbors Kansas, LLC - Wichita, Kansas

Taxon	USEPA Regional Tolerance Value	Functional Feeding Group	ECO-1A 10/3/2013		ECO-1B 10/3/2013		ECO-2 10/3/2013		ECO-3 10/3/2013		ECO-4 10/3/2013		ECO-5 10/3/2013	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Tricladida														
Planariidae														
Dugesia tigrina	7.5	PR	1	0.5%					1	0.6%	3	1.4%		
Branchiobdellida														
Branchiobdellidae														
Xironogiton sp.	6	GC					4	2.0%						
Hirudinida														
Erpobdellidae														
Mooreobdella sp.	7.8	PR					2	1.0%	1	0.6%	1	0.5%		
Megadrili	5	GC	2	1.0%										
Tubificida														
Enchytraeidae	10	GC					4	2.0%						
Naididae														
Dero sp. (tentative)	10	GC	6	3.0%	12	5.4%					1	0.5%	5	2.5%
Tubificinae														
Limnodrilus sp.	9.6	GC			6	2.7%	17	8.4%					1	0.5%
Basommatophora														
Ancylidae														
Ferrissia sp.	5.2	SC	2	1.0%	1	0.5%	2	1.0%					1	0.5%
Planorbiidae														
Micromenetus sp.	7	SC	1	0.5%										
Physidae														
Physa sp.	8	SC	16	7.9%	2	0.9%	4	2.0%	6	3.4%			31	15.3%
Veneroidea														
Corbiculidae														
Corbicula fluminea	3.2	FC	7	3.5%	14	6.3%	38	18.7%	67	38.3%	73	34.4%	8	4.0%
Sphaeriidae														
Musculium transversum	5	FC							1	0.6%				
Pisidium sp..	4.6	FC	1	0.5%										
Amphipoda														
Hyalellidae														
Hyalella azteca gr.	8	GC	80	39.6%	7	3.2%	6	3.0%	17	9.7%	33	15.6%	18	8.9%
Decapoda														
Cambaridae														
Orconectes sp.	2.7	SH			1	0.5%	1	0.5%	1	0.6%				

TABLE 4-6
BENTHIC MACROINVERTEBRATE DATA, COUNTS, AND STATISTICS - CHISHOLM CREEK
Clean Harbors Kansas, LLC - Wichita, Kansas

Taxon	USEPA Regional Tolerance Value	Functional Feeding Group	ECO-1A 10/3/2013		ECO-1B 10/3/2013		ECO-2 10/3/2013		ECO-3 10/3/2013		ECO-4 10/3/2013		ECO-5 10/3/2013	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Ephemeroptera														
Baetidae														
Acerpenna sp.	4	SH			2	0.9%	2	1.0%	1	0.6%			1	0.5%
Baetis sp.	3.1	GC			1	0.5%			1	0.6%				
Caenidae														
Caenis sp.	3.1	GC	6	3.0%	8	3.6%	4	2.0%	2	1.1%	8	3.8%	7	3.5%
Heptageniidae														
Stenacron interpunctatum gr.	7	OM			2	0.9%	2	1.0%						
Leptohyphidae														
Tricorythodes sp.	2.7	GC			3	1.4%	2	1.0%						
Odonata														
Aeschnidae														
Nasiaeschna pentacantha	8	PR					1	0.5%						
Calopterygidae														
Hetaerina sp.	2.8	PR									2	0.9%		
Coenagrionidae														
Argia sp.	5.1	PR	3	1.5%	3	1.4%	16	7.9%	4	2.3%	1	0.5%		
Enallagma	9	PR	2	1.0%	7	3.2%			2	1.1%	8	3.8%	6	3.0%
Hemiptera														
Belostomatidae														
Belostoma sp.	9.8	PR			1	0.5%			1	0.6%				
Corixidae														
Trichocorixa sp.	5	PR	7	3.5%	10	4.5%	8	3.9%	1	0.6%	1	0.5%	4	2.0%
Gerridae	5	PR					1	0.5%						
Veliidae														
Rhagovelia sp.	6	PR			5	2.3%	8	3.9%	11	6.3%				
Trichoptera														
Hydroptilidae														
Hydroptila sp.	3.2	SC	3	1.5%	5	2.3%	2	1.0%	12	6.9%	6	2.8%		
Coleoptera														
Dytiscidae														
Neoporus sp.	5	PR	2	1.0%										
Elmidae														
Dubiraphia sp.	4.7	GC					2	1.0%	1	0.6%			1	0.5%
Stenelmis	3	SC											2	1.0%
Gyrinidae														
Dineutus sp.	3.7	PR							1	0.6%	1	0.5%		
Hydrophilidae														
Berosus sp.	6.7	PR							1	0.6%	2	0.9%		
Paracymus sp.	5	PR	1	0.5%										

TABLE 4-6
BENTHIC MACROINVERTEBRATE DATA, COUNTS, AND STATISTICS - CHISHOLM CREEK
Clean Harbors Kansas, LLC - Wichita, Kansas

Taxon	USEPA Regional Tolerance Value	Functional Feeding Group	ECO-1A 10/3/2013		ECO-1B 10/3/2013		ECO-2 10/3/2013		ECO-3 10/3/2013		ECO-4 10/3/2013		ECO-5 10/3/2013	
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Diptera														
Ceratopogonidae														
Ceratopogon	6	PR							1	0.6%				
Culicoides	10	PR					2	1.0%						
Mallochohelea	5.7	PR	16	7.9%	1	0.5%	4	2.0%					3	1.5%
Chironomidae														
Ablabesmyia mallochi	5	OM											4	2.0%
Cladotanytarsus sp.	4.4	GC	3	1.5%	2	0.9%	4	2.0%	1	0.6%	4	1.9%	4	2.0%
Cricotopus bicinctus gr.	6.7	OM	4	2.0%	58	26.1%	14	6.9%			31	14.6%	22	10.9%
Cryptochironomus fulvus gr.	8	PR							1	0.6%			2	1.0%
Dicrotendipes neomodestus	4.5	FC	4	2.0%	52	23.4%	30	14.8%	2	1.1%	7	3.3%	34	16.8%
Nanocladius minimus	4.5	GC											2	1.0%
Orthocladius complex	3.9	GC	1	0.5%					5	2.9%	7	3.3%		
Paratanytarsus sp.	4.2	GC					2	1.0%	1	0.6%	3	1.4%	3	1.5%
Polypedilum sp.	6	SH							10	5.7%	7	3.3%		
Polypedilum flavum	6	SH			1	0.5%								
Polypedilum illinoense gr.	6.9	SH											2	1.0%
Polypedilum scalaenum gr.	8.7	SH					9	4.4%	9	5.1%	4	1.9%	3	1.5%
Polypedilum tritum	6	SH	27	13.4%	1	0.5%	2	1.0%						
Pseudochironomus sp.	4.7	GC			5	2.3%					2	0.9%	2	1.0%
Tanytarsus sp.	3.5	FC	5	2.5%	7	3.2%	7	3.4%	10	5.7%	7	3.3%	35	17.3%
Thienemanniella sp.	3.7	GC			3	1.4%								
Thienemanniella similis	2.4	GC							1	0.6%				
Thienemanniella taurocapita	3.7	GC					2	1.0%					1	0.5%
Thienemannimyia gr.	6	PR	2	1.0%	2	0.9%			2	1.1%				
Tipulidae														
Erioptera sp.	3	GC					1	0.5%						
Total Specimens			202	100%	222	100%	203	100%	175	100%	212	100%	202	100%
Total Taxa			24		28		31		30		22		25	
Total EPT Taxa			2		6		5		4		2		2	
Total EPT Specimens			9	4.5%	21	9.5%	12	5.9%	16	9.1%	14	6.6%	8	4.0%
# Species Common to This Sample and ECO-5 (a1)			13		16		17		14		13		NA	
# Species Present in ECO-5 but not This Sample (b1)			12		9		8		11		12		NA	
# Species Present in This Sample but not ECO-5 (c1)			11		12		14		16		9		NA	
Modified Hilsenhoff Biotic Index			6.66		5.70		5.51		4.84		5.16		5.75	
Total Gatherer/Collector Specimens			98	48.5%	47	23.3%	48	23.8%	29	14.4%	58	28.7%	44	21.8%
Total Filterer/Collector Specimens			17	8.4%	73	36.1%	75	37.1%	80	39.6%	87	43.1%	77	38.1%
Total Scraper Specimens			22	10.9%	8	4.0%	8	4.0%	18	8.9%	6	3.0%	34	16.8%
Total Chironomidae Specimens			46	22.8%	131	59.0%	70	34.5%	42	24.0%	72	34.0%	114	56.4%
Total EPT Plus Chironomidae Specimens			55	27.2%	152	68.5%	82	40.4%	58	33.1%	86	40.6%	122	60.4%
Total Tolerant Organisms			104	51.5%	35	15.8%	43	21.2%	36	20.6%	46	21.7%	66	32.7%
Number of Most Abundant Taxon			80	39.6%	58	26.1%	38	18.7%	67	38.3%	73	34.4%	35	17.3%
Total Shredder Specimens			27	13.4%	5	2.3%	14	6.9%	21	12.0%	11	5.2%	6	3.0%

Notes:
* Functional feeding groups are designated as follows: PR = predator; OM = omnivore; GC = gatherer/collecter; FC = filterer/collector; SC = scraper; SH = shredder.

TABLE 4-7
CALCULATED METRICS AND MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY - CHISHOLM CREEK
Clean Harbors Kansas, LLC - Wichita, Kansas

Sample Number	ECO-1A			ECO-1B			ECO-2			ECO-3			ECO-4			ECO-5		
Metric	Value	% Comp. to Ref.	Score	Value	% Comp. to Ref.	Score	Value	% Comp. to Ref.	Score	Value	% Comp. to Ref.	Score	Value	% Comp. to Ref.	Score	Value	% Comp. to Ref.	Score
Richness Measures																		
Total Number of Taxa	24	96%	6.0	28	112%	6.0	31	124%	6.0	30	120%	6.0	22	88%	6.0	25	100%	6.0
Number of EPT Taxa	2	100%	6.0	6	300%	6.0	5	250%	6.0	4	200%	6.0	2	100%	6.0	2	100%	6.0
Composition Measures																		
% EPT Specimens	4.5%	113%	6.0	9.5%	239%	6.0	5.9%	149%	6.0	9.1%	231%	6.0	6.6%	167%	6.0	4.0%	100%	6.0
Jaccard Similarity Index	0.4	--	2.2	0.43	--	2.6	0.44	--	2.6	0.34	--	2.0	0.38	--	2.3	1.0	--	6.0
Feeding Measures																		
Ratio of Scrapers/Filterer Collectors	129.4%	293%	6.0	11.0%	25%	2.0	10.7%	24%	2.0	22.5%	51%	6.0	6.9%	16%	0.0	44.2%	100%	6.0
Ratio of Shredders/Total	13.4%	450%	6.0	2.3%	76%	6.0	6.9%	232%	6.0	12.0%	404%	6.0	5.2%	175%	6.0	3.0%	100%	6.0
Tolerance/Intolerance Measures																		
Modified Hilsenhoff Biotic Index	6.66	86%	6.0	5.70	101%	6.0	5.51	104%	6.0	4.84	119%	6.0	5.16	111%	6.0	5.75	100%	6.0
% Dominance Most Common Taxon	39.6%	--	2.0	26.1%	--	4.0	18.7%	--	6.0	38.3%	--	2.0	34.4%	--	2.0	17.3%	--	6.0
% Tolerant Organisms	51.5%	--	0.0	15.8%	--	6.0	21.2%	--	4.0	20.6%	--	4.0	21.7%	--	4.0	32.7%	--	2.0
			Score (MIBI) = 40.2			**Score (MIBI) =** 44.6			**Score (MIBI) =** 44.6			**Score (MIBI) =** 44.0			**Score (MIBI) =** 38.3			**Score (MIBI) =** 50.0

TABLE 5-1
SAMPLE-BY-SAMPLE COMPARISON OF SEDIMENT CONCENTRATIONS TO SCREENING BENCHMARKS
Clean Harbors Kansas, LLC - Wichita, Kansas

Location Description	Invertebrate Sample	Sediment Sample	Barium (mg/kg)	Lead (mg/kg)
Threshold Effects Concentration =			20	35.8
Probable Effects Concentration =			Not Available	130
Upstream reference location; 400 feet upstream from site.	ECO-5	CC-1	**74.3 (TEC)**	12.3
100 feet upstream from ECO-4	- -	CC-2	**89.7 (TEC)**	9.7
100 feet east of the site boundary; 300 feet downstream from ECO-5	ECO-4	CC-3	**155 (TEC)**	10.8
300 feet downstream from ECO-4	ECO-3	CC-4	**51.9 (TEC)**	18.6
300 feet downstream of site and ECO-3	ECO-2	CC-5	**238 (TEC)**	**126 (TEC)**
80 feet downstream of ECO-2	- -	CC-6	**50.1 (TEC)**	15.5
750 feet downstream of site	ECO-1B	CC-7	**200 (TEC)**	6.5
200 feet downstream of CC-7		CC-8	**122 (TEC)**	**3320 (PEC)**
200 feet downstream of CC-8	- -	CC-9	**152 (TEC)**	10
200 feet downstream of CC-9	- -	CC-10	**157 (TEC)**	19.7
2000 feet downstream of site	ECO-1A	CC-11	**36.2 (TEC)**	5.3

Notes:
(TEC) = Concentration exceeds the treshold effects concentration.
(PEC) = Concentration exceeds the probable effects concentration.

TABLE 5-2
SUMMARY OF MACROINVERTEBRATE INDEX OF BIOTIC INTEGRITY AND BIOLOGICAL CONDITIONS - CHISHOLM CREEK
Clean Harbors Kansas, LLC - Wichita, Kansas

Sample Number	ECO-1A	ECO-1B	ECO-2	ECO-3	ECO-4	ECO-5
Sample Location	2000 feet south of the site before 21st Street bridge	750 feet downstream of site	300 feet downstream of site and ECO-3; east of intersection of North New York and East 24th Street North	300 feet downstream from ECO-4; east of intersection of North New York and East 25th Street North	100 feet east of the site boundary; 300 feet downstream from ECO-5	Upstream reference location; 400 feet upstream from site; only sample on eastern side of Interstate-135
Metrics						
Total Number of Taxa	6.0	6.0	6.0	6.0	6.0	6.0
Number of EPT Taxa	6.0	6.0	6.0	6.0	6.0	6.0
% EPT Specimens	6.0	6.0	6.0	6.0	6.0	6.0
Jaccard Similarity Index	2.2	2.6	2.6	2.0	2.3	6.0
Ratio of Scrapers/Filterer Collectors	6.0	2.0	2.0	6.0	0.0	6.0
Ratio of Shredders/Total	6.0	6.0	6.0	6.0	6.0	6.0
Modified Hilsenhoff Biotic Index	6.0	6.0	6.0	6.0	6.0	6.0
% Dominance Most Common Taxon	2.0	4.0	6.0	2.0	2.0	6.0
% Tolerant Organisms	0.0	6.0	4.0	4.0	4.0	2.0
Total MIBI Score	40.2	44.6	44.6	44.0	38.3	50.0
% Comparison to Reference Score	80%	89%	89%	88%	77%	--
Biological Condition Category	Slightly Impaired	Nonimpaired	Nonimpaired	Nonimpaired	Slightly Impaired	Not Applicable
Habitat Assessment Station Score	91	110	118	98	98	102

APPENDIX A

LISTING OF THREATENED AND ENDANGERED SPECIES IN SEDGWICK COUNTY

Kansas Department of Wildlife, Parks and Tourism

Sedgwick County

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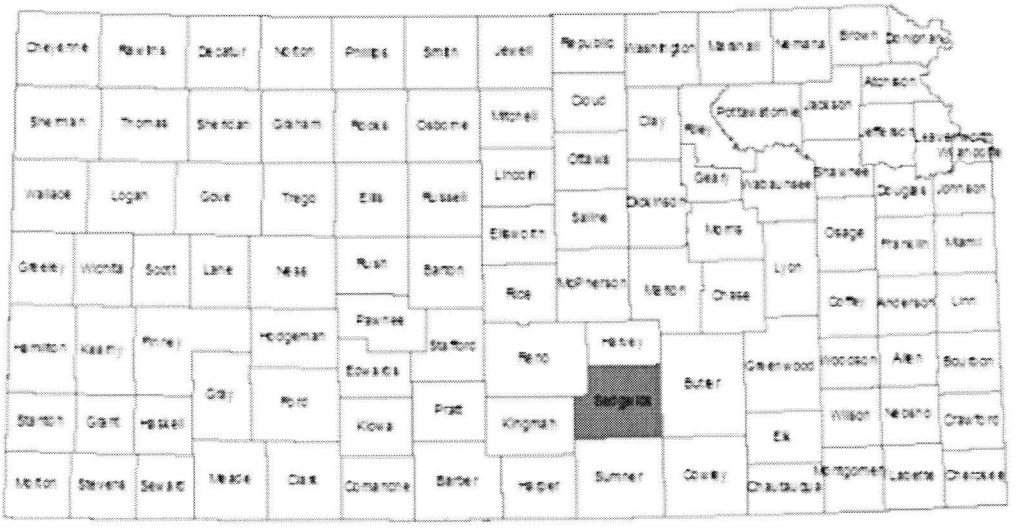


Threatened and Endangered (T&E) Species

EASTERN SPOTTED SKUNK *Spilogale putorius*
State: Threatened **Federal:** N/A **Critical Habitat:** Yes

ARKANSAS DARTER *Etheostoma cragini*
State: Threatened **Federal:** Candidate **Critical Habitat:** Yes

ARKANSAS RIVER SPECKLED CHUB (PEPPERED CHUB) *Macrhybopsis tetranema*
State: Endangered **Federal:** N/A **Critical Habitat:** Yes

SILVER CHUB *Macrhybopsis storeriana*
State: Endangered **Federal:** N/A **Critical Habitat:** Yes

PLAINS MINNOW *Hybognathus placitus*
State: Threatened **Federal:** N/A **Critical Habitat:** Yes

ARKANSAS RIVER SHINER *Notropis girardi*
State: Endangered **Federal:** Threatened **Critical Habitat:** Yes

ESKIMO CURLEW *Numenius borealis*
State: Endangered **Federal:** Endangered **Critical Habitat:** No

PIPING PLOVER *Charadrius melodus*
State: Threatened **Federal:** Threatened **Critical Habitat:** No

SNOWY PLOVER *Charadrius alexandrinus*
State: Threatened **Federal:** N/A **Critical Habitat:** No

LEAST TERN *Sterna antillarum*
State: Endangered **Federal:** Endangered **Critical Habitat:** No

Species In Need of Conservation (SINC)

River Shiner *Notropis blennius*
State: SINC **Federal:** N/A **Critical Habitat:** No

Western Hognose Snake *Heterodon nasicus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Whip-poor-will *Camprimulgus vociferus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Yellow-throated Warbler *Dendroica dominica*
State: SINC **Federal:** N/A **Critical Habitat:** No

Alligator Snapping Turtle *Macrochelys temminckii*
State: SINC **Federal:** N/A **Critical Habitat:** No

Black Tern *Chlidonias niger*
State: SINC **Federal:** N/A **Critical Habitat:** No

Short-eared Owl *Asio flammeus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Chihuahuan Raven *Corvus cryptoleucus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Ferruginous Hawk *Buteo regalis*
State: SINC **Federal:** N/A **Critical Habitat:** No

Golden Eagle *Aquila chrysaetos*
State: SINC **Federal:** N/A **Critical Habitat:** No

Southern Flying Squirrel *Glaucomys volans*
State: SINC **Federal:** N/A **Critical Habitat:** No

Eastern Hognose Snake *Heterodon platirhinos*
State: SINC **Federal:** N/A **Critical Habitat:** No

Black Rail *Laterallus jamaicensis*
State: SINC **Federal:** N/A **Critical Habitat:** No

Bobolink *Dolichonyx oryzivorus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Cerulean Warbler *Dendroica cerulea*
State: SINC **Federal:** N/A **Critical Habitat:** No

Henslow's Sparrow *Ammodramus henslowii*
State: SINC **Federal:** N/A **Critical Habitat:** No

Long-billed Curlew *Numenius americanus*
State: SINC **Federal:** N/A **Critical Habitat:** No

Mountain Plover *Charadrius montanus*
State: SINC **Federal:** N/A **Critical Habitat:** No

APPENDIX B

HABITAT ASSESSMENT FIELD DATA SHEETS

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Near 21st St.

Location / Sample # ECO-1A

Date 10/3/13 **Time** 9:15AM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or (Glide/Pool)

Water Depth 2-12" **Stream Width** 20ft+

Stream Velocity Slow **Distance from Shore** 4ft

Stream Physiochemical Characteristics

Water Temperature (°C)
Dissolved Oxygen (mg/L)
pH
Conductivity

Riparian Zone

Canopy
- [x] > 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Stage
- [ ] High
- [ ] Up
- [x] Normal
- [ ] Low
- [ ] Dry

Aesthetic Characteristics
- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [x] Trash/Litter
- [ ] Stressed Vegetation

Riparian Zone Width: 20ft intermittent
Mod to poor

Ecological Species Observed: frogs, snails, under interstate bridge crayfish

Additional Notes:

rocks on banks + in water, many samples off rocks, 75% rock / 25% sand

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION ECO-1A	
STATION # ____ RIVERMILE ____	STREAM CLASS ____	
LAT ____ LONG ____	RIVER BASIN ____	
STORET # ____	AGENCY RBR	
INVESTIGATORS BF + SG		
FORM COMPLETED BY SG/BF	DATE 10/3/13 TIME 9:15 (AM) PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 (8) 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 (9) 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 (13) 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 (18) 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 91

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Location / Sample # ECO-1B

Date 10/3/13 **Time** 10:30AM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or ~~Glide/Pool~~

Water Depth 0-3ft **Stream Width** 15ft

Stream Velocity Slow **Distance from Shore** 4ft-6ft

Stream Physiochemical Characteristics

Water Temperature (°C)

Dissolved Oxygen (mg/L)

pH

Conductivity

Riparian Zone

Canopy

- [x] > 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Stage

- [ ] High
- [ ] Up
- [x] Normal
- [ ] Low
- [ ] Dry

Aesthetic Characteristics

- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [x] Trash/Litter
- [ ] Stressed Vegetation

Riparian Zone Width: 30ft - intermittent spts better than 1A - denser

Ecological Species Observed: crayfish, clams, water spiders dragonfly larvae,

Additional Notes: thicker riparian zone, more gravel substrate, 50% rock/50% gravel/sand

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION ECO-1B
STATION # _____ RIVERMILE _____	STREAM CLASS
LAT _____ LONG _____	RIVER BASIN
STORET #	AGENCY RBR
INVESTIGATORS BF/SG	
FORM COMPLETED BY BF/SG	DATE 10/3/13 TIME 10:30 AM PM
REASON FOR SURVEY	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by *sediment deposition.*	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the *bottom affected; slight* deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the *bottom affected; sediment* deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom *changing frequently;* pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or *minimal; stream with* normal pattern.	Some channelization present, usually in areas of *bridge abutments*; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments *or shoring structures* present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of *the stream reach* channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 110

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Location / Sample # ECO-2

Date 10/3/13 **Time** 11:30AM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or (Glide/Pool)

Water Depth 18" **Stream Width** ~~15ft~~

Stream Velocity Slow **Distance from Shore** 7ft

Stream Physiochemical Characteristics

Water Temperature (°C)

Dissolved Oxygen (mg/L)

pH

Conductivity

Riparian Zone

Canopy
- [x] 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Riparian Zone Width: 30ft

Stage
- [ ] High
- [ ] Up
- [x] Normal
- [x] Low
- [ ] Dry

Aesthetic Characteristics
- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [x] Trash/Litter
- [ ] Stressed Vegetation

Ecological Species Observed: dragonfly larvae, water spiders, crayfish, clams

Additional Notes: water level a bit lower than other areas, sediment is sand + rocks visible

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION EC0-2
STATION # ___ RIVERMILE ___	STREAM CLASS
LAT ___ LONG ___	RIVER BASIN
STORET #	AGENCY RBR
INVESTIGATORS BF/SG	
FORM COMPLETED BY BF/SG	DATE 10/3/13 TIME 11:30 AM PM / REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or *minimal; stream with* normal pattern.	Some channelization present, usually in areas of *bridge abutments*; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments *or shoring structures* present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of *the stream reach* channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only *minimally*.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 118

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Location / Sample # EC0-3

Date 10/3/13 **Time** 1:02PM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or (Glide/Pool)

Water Depth 0-10-12" **Stream Width** 10ft

Stream Velocity slow **Distance from Shore** 5ft

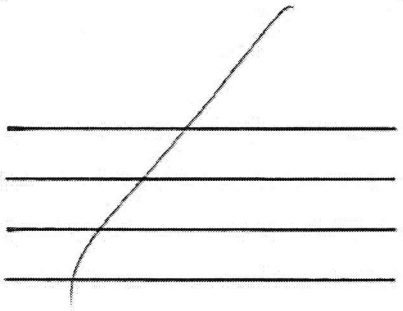
Stream Physiochemical Characteristics

Water Temperature (°C)

Dissolved Oxygen (mg/L)

pH

Conductivity



Riparian Zone

Canopy
- [x] ≥ 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Riparian Zone Width: 30ft

Stage
- [ ] High
- [ ] Up
- [ ] Normal
- [x] Low
- [ ] Dry

Aesthetic Characteristics
- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [x] Trash/Litter
- [ ] Stressed Vegetation

Ecological Species Observed: crayfish, water spiders, little beetles, clams

Additional Notes: Sand bar

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION SCO-3
STATION # / RIVERMILE /	STREAM CLASS /
LAT / LONG	RIVER BASIN /
STORET # /	AGENCY SCBR
INVESTIGATORS SG/BF	
FORM COMPLETED BY SG/BF	DATE 10/3/13 TIME 2:00 AM (PM)
REASON FOR SURVEY /	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 98

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Location / Sample # ECO-4

Date 10/3/13 **Time** 2:00 PM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or (Glide/Pool)

Water Depth <1ft **Stream Width** 15ft

Stream Velocity Slow **Distance from Shore** 7ft

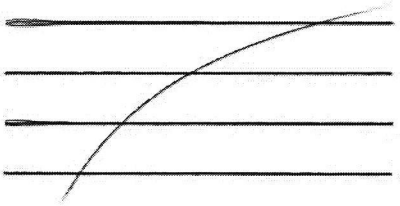
Stream Physiochemical Characteristics

Water Temperature (°C)

Dissolved Oxygen (mg/L)

pH

Conductivity



Riparian Zone

Canopy
- [x] > 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Riparian Zone Width: 30ft

Stage
- [ ] High
- [ ] Up
- [ ] Normal
- [x] Low
- [ ] Dry

Aesthetic Characteristics
- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [x] Trash/Litter
- [ ] Stressed Vegetation

Ecological Species Observed: clams, crayfish, water spiders, water bugs, beetles?

Additional Notes: same as ECO-3 habitat

Sheet of 4

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION 2CO-4	
STATION # ____ RIVERMILE ____	STREAM CLASS ____	
LAT ____ LONG ____	RIVER BASIN ____	
STORET # ____	AGENCY RBR	
INVESTIGATORS SG/BF		
FORM COMPLETED BY SG/BF	DATE 10/3 TIME 2:00 AM (PM)	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 98

QUALITATIVE HABITAT ASSESSMENT FIELD DATA SHEET
AQUATIC HABITAT: CHISHOLM CREEK

Location / Sample # ECO-5

Date 10/3/13 **Time** 4:00 PM

Surveyed By Bruce Fishman & Stephanie Gundling

Habitat Type Riffle/Run or (Glide/Pool)

Water Depth 2ft **Stream Width** 12ft-15ft

Stream Velocity slow **Distance from Shore** 6ft

Stream Physiochemical Characteristics

Water Temperature (°C) _____

Dissolved Oxygen (mg/L) _____

pH _____

Conductivity _____

Riparian Zone

Canopy

- [x] > 85% - Open
- [ ] 55% - 85%
- [ ] 30% < 55%
- [ ] 10% < 30%
- [ ] < 10% - Closed

Riparian Zone Width: 30ft

Stage

- [ ] High
- [ ] Up
- [ ] Normal
- [x] Low
- [ ] Dry

Aesthetic Characteristics

- [ ] Nuisance algae
- [ ] Odor
- [ ] Excess turbidity
- [ ] Discoloration
- [ ] Foam/Scum
- [ ] Sheen
- [ ] Trash/Litter
- [ ] Stressed Vegetation

Ecological Species Observed: NO CLAMS, dragonfly larvae, water striders, worm, snail

Additional Notes: more seaweed some samples taken from seaweed, more aquatic vegetation than other locations

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME CHISHOLM CREEK	LOCATION ECO-5
STATION # _____ RIVERMILE _____	STREAM CLASS _____
LAT _____ LONG _____	RIVER BASIN _____
STORET # _____	AGENCY RBP
INVESTIGATORS BF/SG	
FORM COMPLETED BY BF/SG	DATE 10/3/13 TIME 4:00 AM (PM)
REASON FOR SURVEY	

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

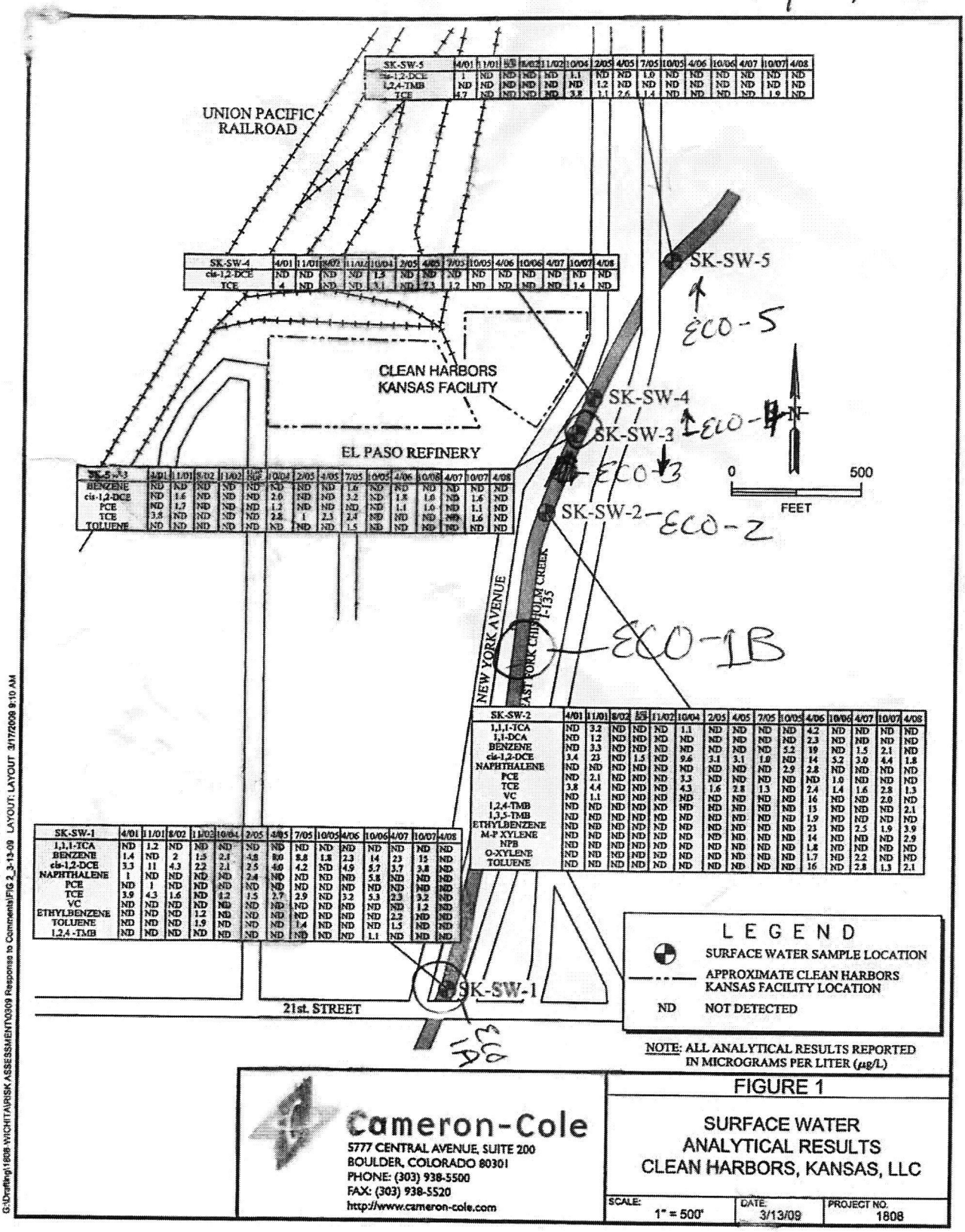
HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score 102

10/3/13



SK-SW-5	4/01	11/01	8/02	11/02	10/04	2/05	4/05	7/05	10/05	4/06	10/06	4/07	10/07	4/08
cis-1,2-DCE	1	ND	ND	ND	1.1	ND	ND	1.0	ND	ND	ND	ND	ND	ND
1,2,4-TMB	ND	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND
TCE	4.7	ND	ND	ND	3.8	1.1	2.6	1.4	ND	ND	ND	ND	1.9	ND

SK-SW-4	4/01	11/01	8/02	11/02	10/04	2/05	4/05	7/05	10/05	4/06	10/06	4/07	10/07	4/08
cis-1,2-DCE	ND	ND	ND	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	4	ND	ND	ND	3.1	ND	2.3	1.2	ND	ND	ND	ND	1.4	ND

SK-SW-3	4/01	11/01	8/02	11/02	10/04	2/05	4/05	7/05	10/05	4/06	10/06	4/07	10/07	4/08
BENZENE	ND	ND	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND	ND	ND
cis-1,2-DCE	ND	1.6	ND	ND	ND	2.0	ND	3.2	ND	1.8	1.0	ND	1.6	ND
PCE	ND	1.7	ND	ND	ND	1.2	ND	ND	ND	1.1	1.0	ND	1.1	ND
TCE	3.5	ND	ND	ND	ND	2.8	1	2.3	2.4	ND	ND	ND	1.6	ND
TOLUENE	ND	ND	ND	ND	ND	ND	ND	1.5	ND	ND	ND	ND	ND	ND

SK-SW-2	4/01	11/01	8/02	5/3	11/02	10/04	2/05	4/05	7/05	10/05	4/06	10/06	4/07	10/07	4/08
1,1,1-TCA	ND	3.2	ND	ND	ND	1.1	ND	ND	ND	ND	4.2	ND	ND	ND	ND
1,1-DCA	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND
BENZENE	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	5.2	19	ND	1.5	2.1	ND
cis-1,2-DCE	3.4	23	ND	1.5	ND	9.6	3.1	3.1	1.0	ND	14	5.2	3.0	4.4	1.8
NAPHTHALENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.9	2.8	ND	ND	ND
PCE	ND	2.1	ND	ND	ND	3.3	ND	ND	ND	ND	ND	1.0	ND	ND	ND
TCE	3.8	4.4	ND	ND	ND	4.3	1.6	2.8	1.3	ND	2.4	1.4	1.6	2.8	1.3
VC	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	16	ND	ND	2.0	ND
1,2,4-TMB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	13	ND	ND	ND	2.1
1,3,5-TMB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.9	ND	ND	ND	ND
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	23	ND	2.5	1.9	3.9
M-P XYLENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	14	ND	ND	ND	2.9
NPB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.8	ND	ND	ND	ND
O-XYLENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.7	ND	2.2	ND	ND
TOLUENE	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	16	ND	2.8	1.3	2.1

SK-SW-1	4/01	11/01	8/02	11/02	10/04	2/05	4/05	7/05	10/05	4/06	10/06	4/07	10/07	4/08
1,1,1-TCA	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
BENZENE	1.4	ND	2	1.5	2.1	4.8	80	5.8	1.8	2.3	14	23	15	ND
cis-1,2-DCE	3.3	11	4.3	2.2	2.1	2.5	40	4.2	ND	4.9	5.7	3.7	3.8	ND
NAPHTHALENE	1	ND	ND	ND	ND	2.4	ND	ND	ND	ND	5.8	ND	ND	ND
PCE	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
TCE	3.9	4.3	1.6	ND	8.2	1.5	2.7	2.9	ND	3.2	5.3	2.3	3.2	ND
VC	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.2	ND
ETHYLBENZENE	ND	ND	ND	1.2	ND	ND	ND	ND	ND	ND	ND	2.2	ND	ND
TOLUENE	ND	ND	ND	1.9	ND	ND	ND	1.4	ND	ND	ND	1.5	ND	ND
1,2,4 -TMB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.1	ND	ND	ND

Cameron-Cole
5777 CENTRAL AVENUE, SUITE 200
BOULDER, COLORADO 80301
PHONE: (303) 938-5500
FAX: (303) 938-5520
http://www.cameron-cole.com

FIGURE 1

SURFACE WATER ANALYTICAL RESULTS
CLEAN HARBORS, KANSAS, LLC

SCALE:	DATE:	PROJECT NO.
1" = 500'	3/13/09	1808

G:\Drafting\1808 WICHITA\RISK ASSESSMENT\0309 Response to Comments\FIG 2_3-13-09 LAYOUT: LAYOUT 3/17/2009 9:10 AM

APPENDIX C

MACROINVERTEBRATE SAMPLE RESULTS

Benthic macroinvertebrates collected by Risk Based Remedies (RBR Consulting, Inc.)

Collection Gear:	Kick Net	Sample Location											
Collection Date:	October 3, 2013	ECO - 1A		ECO - 1B		ECO - 2		ECO - 3		ECO - 4		ECO - 5	
Taxon:	Common Name	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Tricladida													
Planariidae													
Dugesia tigrina	flat worm	1	0.5%					1	0.6%	3	1.4%		
Branchiobdellida													
Branchiobdellidae													
Xironogiton sp.	crayfish worm					4	2.0%						
Hirudinida													
Erpobdellidae													
Mooreobdella sp.	leech					2	1.0%	1	0.6%	1	0.5%		
Megadrili	earth worm	2	1.0%										
Tubificida													
Enchytraeidae	earth worm					4	2.0%						
Naididae													
Dero sp. (tentative)	naiad worm	6	3.0%	12	5.4%					1	0.5%	5	2.5%
Tubificinae													
Limnodrilus sp.	tube worm			6	2.7%	17	8.4%					1	0.5%
Basommatophora													
Ancylidae													
Ferrissia sp.	limpet snail	2	1.0%	1	0.5%	2	1.0%					1	0.5%
Planorbiidae													
Micromenetus sp.	orb Snail	1	0.5%										
Physidae													
Physa sp.	pouch snail	16	7.9%	2	0.9%	4	2.0%	6	3.4%			31	15.3%
Veneroidea													
Corbiculidae													
Corbicula fluminea	Asiatic clam	7	3.5%	14	6.3%	38	18.7%	67	38.3%	73	34.4%	8	4.0%
Sphaeriidae													
Musculium transversum	fingernail clam							1	0.6%				
Pisidium sp.	pill clam	1	0.5%										
Amphipoda													
Hyalellidae													
Hyalella azteca gr.	side swimmer	80	39.6%	7	3.2%	6	3.0%	17	9.7%	33	15.6%	18	8.9%
Decapoda													
Cambaridae													
Orconectes sp.	crayfish			1	0.5%	1	0.5%	1	0.6%				
Ephemeroptera													
Baetidae													
Acerpenna sp.	mayfly			2	0.9%	2	1.0%	1	0.6%			1	0.5%
Baetis sp.	mayfly			1	0.5%			1	0.6%				
Caenidae													
Caenis sp.	mayfly	6	3.0%	8	3.6%	4	2.0%	2	1.1%	8	3.8%	7	3.5%
Heptageniidae													
Stenacron interpunctatum gr.	mayfly			2	0.9%	2	1.0%						
Leptohyphidae													
Tricorythodes sp.	mayfly			3	1.4%	2	1.0%						
Odonata													
Aeschnidae													
Nasiaeschna pentacantha	dragonfly					1	0.5%						
Calopterygidae													
Hetaerina sp.	damselfly									2	0.9%		
Coenigrionidae													
Argia sp.	damselfly	3	1.5%	3	1.4%	16	7.9%	4	2.3%	1	0.5%		
Enallagma sp.	damselfly	2	1.0%	7	3.2%			2	1.1%	8	3.8%	6	3.0%
Hemiptera													
Belostomatidae													
Belostoma sp.	giant water bug			1	0.5%			1	0.6%				

Benthic macroinvertebrates collected by Risk Based Remedies (RBR Consulting, Inc.)

Collection Gear:	Kick Net	Sample Location											
Collection Date:	October 3, 2013	ECO - 1A		ECO - 1B		ECO - 2		ECO - 3		ECO - 4		ECO - 5	
Taxon:	Common Name	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Hemiptera continued)													
Corixidae													
Trichocorixa sp.	water boatman	7	3.5%	10	4.5%	8	3.9%	1	0.6%	1	0.5%	4	2.0%
Gerridae	water strider					1	0.5%						
Veliidae													
Rhagovelia sp.	water treader			5	2.3%	8	3.9%	11	6.3%				
Trichoptera													
Hydroptilidae													
Hydroptila sp.	caddisfly	3	1.5%	5	2.3%	2	1.0%	12	6.9%	6	2.8%		
Coleoptera													
Dytiscidae													
Neoporus sp.	diving beetle	2	1.0%										
Elmidae													
Dubiraphia sp.	riffle beetle					2	1.0%	1	0.6%			1	0.5%
Stenelmis sp.	riffle beetle											2	1.0%
Gyrinidae													
Dineutus sp.	whirligig beetle							1	0.6%	1	0.5%		
Hydrophilidae													
Berosus sp.	scavenger beetle							1	0.6%	2	0.9%		
Paracymus sp.	scavenger beetle	1	0.5%										
Diptera													
Ceratopogonidae													
Ceratopogon	sand fly							1	0.6%				
Culicoides sp.	sand fly					2	1.0%						
Mallochohelea sp.	sand fly	16	7.9%	1	0.5%	4	2.0%					3	1.5%
Chironomidae													
Ablabesmyia mallochi	midge											4	2.0%
Cladotanytarsus sp.	midge	3	1.5%	2	0.9%	4	2.0%	1	0.6%	4	1.9%	4	2.0%
Cricotopus bicinctus gr.	midge	4	2.0%	58	26.1%	14	6.9%			31	14.6%	22	10.9%
Cryptochironomus fulvus gr.	midge							1	0.6%			2	1.0%
Dicrotendipes neomodestus	midge	4	2.0%	52	23.4%	30	14.8%	2	1.1%	7	3.3%	34	16.8%
Nanocladius minimus	midge											2	1.0%
Orthocladius complex	midge	1	0.5%					5	2.9%	7	3.3%		
Paratanytarsus sp.	midge					2	1.0%	1	0.6%	3	1.4%	3	1.5%
Polypedilum sp.	midge							10	5.7%	7	3.3%		
Polypedilum flavum	midge			1	0.5%								
Polypedilum illinoense gr.	midge											2	1.0%
Polypedilum scalaenum gr.	midge					9	4.4%	9	5.1%	4	1.9%	3	1.5%
Polypedilum tritum	midge	27	13.4%	1	0.5%	2	1.0%						
Pseudochironomus sp.	midge			5	2.3%					2	0.9%	2	1.0%
Tanytarsus sp.	midge	5	2.5%	7	3.2%	7	3.4%	10	5.7%	7	3.3%	35	17.3%
Thienemanniella sp.	midge			3	1.4%								
Thienemanniella similis	midge							1	0.6%				
Thienemanniella taurocapita	midge					2	1.0%					1	0.5%
Thienemannimyia gr.	midge	2	1.0%	2	0.9%			2	1.1%				
Tipulidae													
Erioptera sp.	crane fly					1	0.5%						
Total Taxa		**24**	100.0%	**28**	100.0%	**31**	100.0%	**30**	100.0%	**22**	100.0%	**25**	100.0%
Total Specimens		202		222		203		175		212		202	

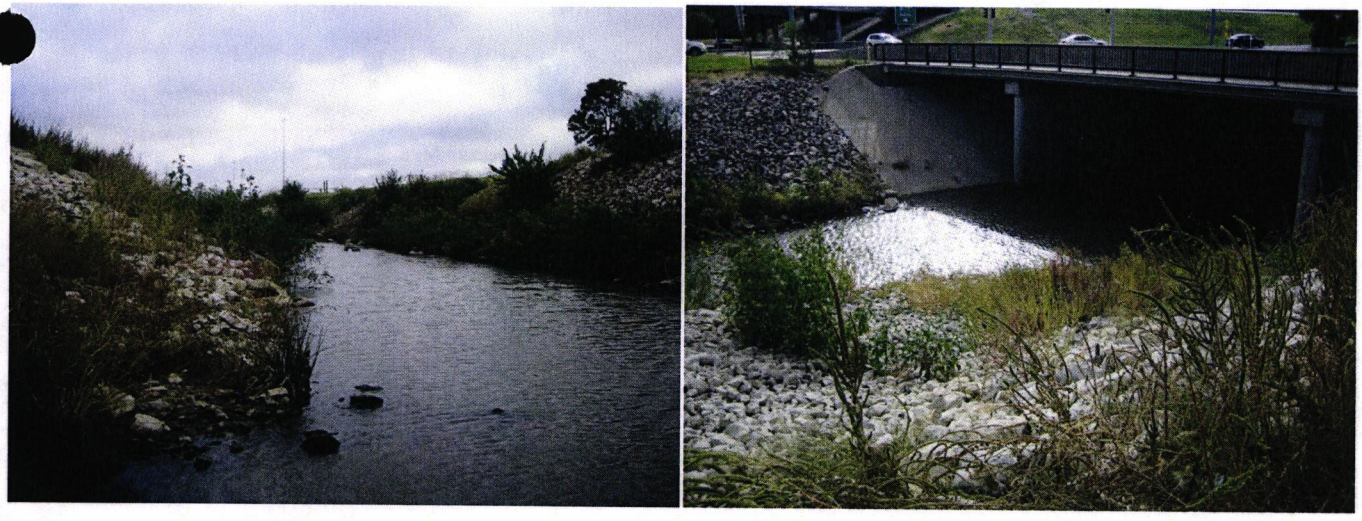


Figure 1: ECO-1A sampling location.

Figure 2: ECO-1B sampling location.

Figure 3: ECO-2 sampling location.

Figure 4: ECO-3 sampling location.

Figure 5: ECO-4 sampling location.

Figure 6: ECO-5 sampling location.

APPENDIX D

SEDIMENT, SURFACE WATER, AND PORE WATER ANALYTICAL RESULTS

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	CC-1 10/4/2013 Investigation	CC-2 10/4/2013 Investigation	CC-3 10/4/2013 Investigation	CC-4 10/4/2013 Investigation	CC-5 10/8/2013 Investigation	CC-6 10/9/2013 Investigation
Semi-volatile Organics (mg/kg)							
Benzoic Acid	65850	< 1	< 0.98	< 0.97	< 0.98	< 0.98	< 0.98
2-Chlorophenol	95578	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Chloro-3-methyl phenol	59507	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4-Dichlorophenol	120832	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4-Dimethylphenol	105679	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4-Dinitrophenol	51285	< 1	< 0.98	< 0.97	< 0.98	< 0.98	< 0.98
4,6-Dinitro-o-cresol	534521	< 0.42	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39
2-Methylphenol	95487	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
3&4-Methylphenol	NA	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2-Nitrophenol	88755	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Nitrophenol	100027	< 1	< 0.98	< 0.97	< 0.98	< 0.98	< 0.98
Pentachlorophenol	87865	< 1	< 0.98	< 0.97	< 0.98	< 0.98	< 0.98
Phenol	108952	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4,5-Trichlorophenol	95954	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4,6-Trichlorophenol	88062	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Acenaphthene	83329	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Acenaphthylene	208968	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Aniline	62533	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Anthracene	120127	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Benzidine	92875	< 2.1	< 2	< 1.9	< 2	< 2	< 2
Benzo(a)anthracene	56553	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Benzo(a)pyrene	50328	< 0.21	0.0611 J	< 0.19	< 0.2	< 0.2	< 0.2
Benzo(b)fluoranthene	205992	< 0.21	0.0679 J	< 0.19	< 0.2	< 0.2	< 0.2
Benzo(g,h,i)perylene	191242	< 0.21	0.089 J	< 0.19	< 0.2	< 0.2	< 0.2
Benzo(k)fluoranthene	207089	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Bromophenyl phenyl ether	101553	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Butyl benzyl phthalate	85687	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Benzyl Alcohol	100516	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2-Chloronaphthalene	91587	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Chloroaniline	106478	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Carbazole	86748	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Chrysene	218019	< 0.21	0.0501 J	< 0.19	< 0.2	< 0.2	< 0.2
bis(2-Chloroethoxy)methane	111911	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
bis(2-Chloroethyl)ether	111444	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
bis(2-Chloroisopropyl)ether	108601	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Chlorophenyl phenyl ether	7005723	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
1,2-Dichlorobenzene	95501	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	CC-1 10/4/2013 Investigation	CC-2 10/4/2013 Investigation	CC-3 10/4/2013 Investigation	CC-4 10/4/2013 Investigation	CC-5 10/8/2013 Investigation	CC-6 10/9/2013 Investigation
Semi-volatile Organics (mg/kg) (continued)							
1,2-Diphenylhydrazine	122667	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
1,3-Dichlorobenzene	541731	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
1,4-Dichlorobenzene	106467	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,4-Dinitrotoluene	121142	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2,6-Dinitrotoluene	606202	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
3,3'-Dichlorobenzidine	91941	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Dibenzo(a,h)anthracene	53703	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Dibenzofuran	132649	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Di-n-butyl phthalate	84742	< 0.42	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39
Di-n-octyl phthalate	117840	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Diethyl phthalate	84662	< 0.42	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39
Dimethyl phthalate	131113	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
bis(2-Ethylhexyl)phthalate	117817	< 0.42	< 0.39	< 0.39	< 0.39	< 0.4	< 0.39
Fluoranthene	206440	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Fluorene	86737	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Hexachlorobenzene	118741	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Hexachlorobutadiene	87683	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Hexachlorocyclopentadiene	77474	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Hexachloroethane	67721	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Indeno(1,2,3-cd)pyrene	193395	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Isophorone	78591	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
1-Methylnaphthalene	90120	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2-Methylnaphthalene	91576	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
2-Nitroaniline	88744	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
3-Nitroaniline	99092	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
4-Nitroaniline	100016	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Naphthalene	91203	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Nitrobenzene	98953	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
N-Nitrosodimethylamine	62759	< 0.42	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39
N-Nitroso-di-n-propylamine	621647	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
N-Nitrosodiphenylamine	86306	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Phenanthrene	85018	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Pyrene	129000	< 0.21	0.0235 J	< 0.19	< 0.2	< 0.2	< 0.2
Pyridine	110861	< 0.42	< 0.39	< 0.39	< 0.39	< 0.39	< 0.39
1,2,4-Trichlorobenzene	120821	< 0.21	< 0.2	< 0.19	< 0.2	< 0.2	< 0.2
Toxaphene	8001352	< 0.1	< 0.099	< 0.097	< 0.097	< 0.097	< 0.098

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Constituent	Sample Identification / Sample Date / Sample Type / CAS No.	CC-1 10/4/2013 Investigation	CC-2 10/4/2013 Investigation	CC-3 10/4/2013 Investigation	CC-4 10/4/2013 Investigation	CC-5 10/8/2013 Investigation	CC-6 10/9/2013 Investigation
Metals (mg/kg)							
Arsenic	7440382	7.6	5.9	13.4 c	6.9	2.9	8.8
Barium	7440393	74.3	89.7	155 c	51.9	238	50.1
Cadmium	7440439	< 0.25	< 0.18	< 0.36 c	< 0.23	< 0.19	< 0.77 c
Chromium	7440473	6.8	10.8	6.9 c	4.7	3.5	3.7 c
Lead	7439921	12.3	9.7	10.8 c	18.6	126	15.5 c
Mercury	7439976	< 0.049	< 0.044	< 0.045	< 0.045	< 0.045	< 0.043
Selenium	7782492	< 1.2	< 0.89	< 1.8 c	< 1.1	< 0.97	< 3.9 c
Silver	7440224	< 0.62	< 0.44	< 0.9 c	< 0.57	< 0.48	< 0.39
General Chemistry							
Percent Solids (%)	NA	79	83.9	84.6	84.7	85.5	85.2
Total Organic Carbon (mg/kg)	NA	3890	5090	2570	2170	< 1200	< 1200

Notes:
All detection limits based on Reporting Limit (RL) values.
NA- Not Available
J- Estimated Value
c- Elevated reporting limit(s) due to matrix interference.

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	CC-7 10/11/2013 Investigation	CC-8 10/11/2013 Investigation	CC-9 10/11/2013 Investigation	CC-10 10/11/2013 Investigation	CC-11 10/11/2013 Investigation
Semi-volatile Organics (mg/kg)						
Benzoic Acid	65850	< 0.98	< 1	< 1.1	< 1.1	< 0.99
2-Chlorophenol	95578	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
4-Chloro-3-methyl phenol	59507	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4-Dichlorophenol	120832	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4-Dimethylphenol	105679	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4-Dinitrophenol	51285	< 0.98	< 1	< 1.1	< 1.1	< 0.99
4,6-Dinitro-o-cresol	534521	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
2-Methylphenol	95487	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
3&4-Methylphenol	NA	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2-Nitrophenol	88755	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
4-Nitrophenol	100027	< 0.98	< 1	< 1.1	< 1.1	< 0.99
Pentachlorophenol	87865	< 0.98	< 1	< 1.1	< 1.1	< 0.99
Phenol	108952	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4,5-Trichlorophenol	95954	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4,6-Trichlorophenol	88062	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Acenaphthene	83329	< 0.2	< 0.21	0.033 J	< 0.23	< 0.2
Acenaphthylene	208968	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Aniline	62533	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Anthracene	120127	< 0.2	< 0.21	0.0264 J	< 0.23	< 0.2
Benzidine	92875	< 2	< 2.1	< 2.1	< 2.3	< 2
Benzo(a)anthracene	56553	< 0.2	< 0.21	< 0.21	0.032 J	< 0.2
Benzo(a)pyrene	50328	< 0.2	< 0.21	< 0.21	0.0368 J	< 0.2
Benzo(b)fluoranthene	205992	< 0.2	< 0.21	< 0.21	0.0659 J	< 0.2
Benzo(g,h,i)perylene	191242	< 0.2	< 0.21	< 0.21	0.0652 J	< 0.2
Benzo(k)fluoranthene	207089	< 0.2	< 0.21	< 0.21	0.0296 J	< 0.2
4-Bromophenyl phenyl ether	101553	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Butyl benzyl phthalate	85687	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Benzyl Alcohol	100516	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2-Chloronaphthalene	91587	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
4-Chloroaniline	106478	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Carbazole	86748	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Chrysene	218019	< 0.2	< 0.21	< 0.21	0.0622 J	< 0.2
bis(2-Chloroethoxy)methane	111911	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
bis(2-Chloroethyl)ether	111444	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
bis(2-Chloroisopropyl)ether	108601	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
4-Chlorophenyl phenyl ether	7005723	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
1,2-Dichlorobenzene	95501	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification Sample Date Sample Type Constituent	CAS No.	CC-7 10/11/2013 Investigation	CC-8 10/11/2013 Investigation	CC-9 10/11/2013 Investigation	CC-10 10/11/2013 Investigation	CC-11 10/11/2013 Investigation
Semi-volatile Organics (mg/kg) (continued)						
1,2-Diphenylhydrazine	122667	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
1,3-Dichlorobenzene	541731	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
1,4-Dichlorobenzene	106467	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,4-Dinitrotoluene	121142	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2,6-Dinitrotoluene	606202	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
3,3'-Dichlorobenzidine	91941	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Dibenzo(a,h)anthracene	53703	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Dibenzofuran	132649	< 0.2	< 0.21	0.0246 J	< 0.23	< 0.2
Di-n-butyl phthalate	84742	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
Di-n-octyl phthalate	117840	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Diethyl phthalate	84662	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
Dimethyl phthalate	131113	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
bis(2-Ethylhexyl)phthalate	117817	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
Fluoranthene	206440	< 0.2	< 0.21	0.0224 J	0.0654 J	< 0.2
Fluorene	86737	< 0.2	< 0.21	0.0606 J	< 0.23	< 0.2
Hexachlorobenzene	118741	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Hexachlorobutadiene	87683	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Hexachlorocyclopentadiene	77474	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Hexachloroethane	67721	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Indeno(1,2,3-cd)pyrene	193395	< 0.2	< 0.21	< 0.21	0.0409 J	< 0.2
Isophorone	78591	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
1-Methylnaphthalene	90120	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2-Methylnaphthalene	91576	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
2-Nitroaniline	88744	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
3-Nitroaniline	99092	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
4-Nitroaniline	100016	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Naphthalene	91203	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Nitrobenzene	98953	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
N-Nitrosodimethylamine	62759	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
N-Nitroso-di-n-propylamine	621647	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
N-Nitrosodiphenylamine	86306	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Phenanthrene	85018	< 0.2	< 0.21	< 0.21	0.0269 J	< 0.2
Pyrene	129000	< 0.2	< 0.21	0.0361 J	0.0572 J	< 0.2
Pyridine	110861	< 0.39	< 0.41	< 0.42	< 0.46	< 0.4
1,2,4-Trichlorobenzene	120821	< 0.2	< 0.21	< 0.21	< 0.23	< 0.2
Toxaphene	8001352	< 0.097	< 0.1	< 0.1	< 0.11	< 0.097

Table D-1

Sediment Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Constituent	Sample Identification / Sample Date / Sample Type / CAS No.	CC-7 10/11/2013 Investigation		CC-8 10/11/2013 Investigation		CC-9 10/11/2013 Investigation		CC-10 10/11/2013 Investigation		CC-11 10/11/2013 Investigation	
Metals (mg/kg)											
Arsenic	7440382	3.9		5.8		3.5		5		2.3	
Barium	7440393	200		122		152		157		36.2	
Cadmium	7440439	< 0.84	c	0.35		< 0.18		< 0.22		< 0.19	
Chromium	7440473	4	c	8.7		5.8		11		2	
Lead	7439921	6.5	c	3320		10		19.7		5.3	
Mercury	7439976	< 0.046		< 0.046		< 0.048		< 0.051		< 0.048	
Selenium	7782492	< 4.2	c	< 0.91		< 0.91		< 1.1		< 0.96	
Silver	7440224	< 0.53		< 0.45		< 0.46		< 0.54		< 0.48	
General Chemistry											
Percent Solids (%)	NA	85.8		81.8		80.4		73.5		84.4	
Total Organic Carbon (mg/kg)	NA	2680		3370		4000		12300		2040	

Notes:
All detection limits based on Reporting Limit (RL) values.
NA- Not Available
J- Estimated Value
c- Elevated reporting limit(s) due to matrix interference.

Table D-2

Surface Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification		SW-BS-1		SW-BS-2		SW-BS-3		SW-BS-4		SW-BS-5	
Sample Date		10/18/2013		10/18/2013		10/18/2013		10/18/2013		10/18/2013	
Sample Type		Investigation		Investigation		Investigation		Investigation		Investigation	
Constituent	CAS No.										
Volatile Organics (µg/L)											
Acetone	67641	< 25	a	< 25	a	< 25	a	< 25	a	< 25	a
Acrolein	107028	< 20		< 20		< 20		< 20		< 20	
Acrylonitrile	107131	< 10		< 10		< 10		< 10		< 10	
Benzene	71432	< 1		< 1		< 1		< 1		< 1	
Bromobenzene	108861	< 1		< 1		< 1		< 1		< 1	
Bromochloromethane	74975	< 1		< 1		< 1		< 1		< 1	
Bromodichloromethane	75274	< 1		< 1		< 1		< 1		< 1	
Bromoform	75252	< 1		< 1		< 1		< 1		< 1	
n-Butylbenzene	104518	< 1		< 1		< 1		< 1		< 1	
sec-Butylbenzene	135988	< 1		< 1		< 1		< 1		< 1	
tert-Butylbenzene	98066	< 1		< 1		< 1		< 1		< 1	
Chlorobenzene	108907	< 1		< 1		< 1		< 1		< 1	
Chloroethane	75003	< 2		< 2		< 2		< 2		< 2	
Chloroform	67663	< 1		< 1		< 1		< 1		< 1	
o-Chlorotoluene	95498	< 1		< 1		< 1		< 1		< 1	
p-Chlorotoluene	106434	< 1		< 1		< 1		< 1		< 1	
2-Chloroethyl vinyl ether	110758	< 5		< 5		< 5		< 5		< 5	
Carbon disulfide	75150	< 2		< 2		< 2		< 2		< 2	
Carbon tetrachloride	56235	< 1		< 1		< 1		< 1		< 1	
1,1-Dichloroethane	75343	< 1		< 1		< 1		< 1		< 1	
1,1-Dichloroethylene	75354	< 1		< 1		< 1		< 1		< 1	
1,1-Dichloropropene	563586	< 1		< 1		< 1		< 1		< 1	
1,2-Dibromo-3-chloropropane	96128	< 2		< 2		< 2		< 2		< 2	
1,2-Dibromoethane	106934	< 1		< 1		< 1		< 1		< 1	
1,2-Dichloroethane	107062	< 1		< 1		< 1		< 1		< 1	
1,2-Dichloropropane	78875	< 1		< 1		< 1		< 1		< 1	
1,3-Dichloropropane	142289	< 1		< 1		< 1		< 1		< 1	
1,4-Dioxane	123911	< 200		< 200		< 200		< 200		< 200	
2,2-Dichloropropane	594207	< 1		< 1		< 1		< 1		< 1	
Dibromochloromethane	124481	< 1		< 1		< 1		< 1		< 1	
Dichlorodifluoromethane	75718	< 2	a	< 2	a	< 2	a	< 2	a	< 2	a
cis-1,2-Dichloroethylene	156592	< 1		< 1		< 1		< 1		< 1	
cis-1,3-Dichloropropene	10061015	< 1		< 1		< 1		< 1		< 1	
m-Dichlorobenzene	541731	< 1		< 1		< 1		< 1		< 1	
o-Dichlorobenzene	95501	< 1		< 1		< 1		< 1		< 1	
p-Dichlorobenzene	106467	< 1		< 1		< 1		< 1		< 1	
trans-1,2-Dichloroethylene	156605	< 1		< 1		< 1		< 1		< 1	
trans-1,3-Dichloropropene	10061026	< 1		< 1		< 1		< 1		< 1	

Table D-2

Surface Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification		SW-BS-1		SW-BS-2		SW-BS-3		SW-BS-4		SW-BS-5	
Sample Date		10/18/2013		10/18/2013		10/18/2013		10/18/2013		10/18/2013	
Sample Type		Investigation		Investigation		Investigation		Investigation		Investigation	
Constituent	CAS No.										
Volatile Organics (µg/L) (continued)											
Ethylbenzene	100414	< 1		< 1		< 1		< 1		< 1	
2-Hexanone	591786	< 10		< 10		< 10		< 10		< 10	
Hexachlorobutadiene	87683	< 2		< 2		< 2		< 2		< 2	
Isopropylbenzene	98828	< 1		< 1		< 1		< 1		< 1	
p-Isopropyltoluene	99876	< 1		< 1		< 1		< 1		< 1	
4-Methyl-2-pentanone	108101	< 5		< 5		< 5		< 5		< 5	
Methyl bromide	74839	< 2		< 2		< 2		< 2		< 2	
Methyl chloride	74873	< 2		< 2		< 2		< 2		< 2	
Methylene bromide	74953	< 2		< 2		< 2		< 2		< 2	
Methylene chloride	75092	< 5		< 5		< 5		< 5		< 5	
Methyl ethyl ketone	78933	< 5		< 5		< 5		< 5		< 5	
Methyl Tert Butyl Ether	1634044	< 1		< 1		< 1		< 1		< 1	
Naphthalene	91203	< 3		< 3		< 3		< 3		< 3	
n-Propylbenzene	103651	< 1		< 1		< 1		< 1		< 1	
Styrene	100425	< 1		< 1		< 1		< 1		< 1	
1,1,1,2-Tetrachloroethane	630206	< 1		< 1		< 1		< 1		< 1	
1,1,1-Trichloroethane	71556	< 1		< 1		< 1		< 1		< 1	
1,1,2,2-Tetrachloroethane	79345	< 1		< 1		< 1		< 1		< 1	
1,1,2-Trichloroethane	79005	< 1		< 1		< 1		< 1		< 1	
1,2,3-Trichlorobenzene	87616	< 1		< 1		< 1		< 1		< 1	
1,2,3-Trichloropropane	96184	< 2		< 2		< 2		< 2		< 2	
1,2,4-Trichlorobenzene	120821	< 1		< 1		< 1		< 1		< 1	
1,2,4-Trimethylbenzene	95636	< 2		< 2		< 2		< 2		< 2	
1,3,5-Trimethylbenzene	108678	< 2		< 2		< 2		< 2		< 2	
Tetrachloroethylene	127184	< 1		< 1		< 1		< 1		< 1	
Toluene	108883	< 1		< 1		< 1		< 1		< 1	
Trichloroethylene	79016	0.54	J	0.75	J	0.52	J	0.57	J	0.47	J
Trichlorofluoromethane	75694	< 2		< 2		< 2		< 2		< 2	
Vinyl chloride	75014	< 1		< 1		< 1		< 1		< 1	
Vinyl Acetate	108054	< 10		< 10		< 10		< 10		< 10	
m,p-Xylene	NA	< 2		< 2		< 2		< 2		< 2	
o-Xylene	95476	< 1		< 1		< 1		< 1		< 1	

Notes:
All detection limits based on Reporting Limit (RL) values.
NA- Not Available
J- Estimated Value
a- Associated BS recovery outside control limits.

Table D-2

Surface Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	SR-SW-1 10/18/2013 Investigation	SR-SW-2 10/18/2013 Investigation	SR-SW-3 10/18/2013 Investigation	SR-SW-4 10/18/2013 Investigation	SR-SW-5 10/18/2013 Investigation
Volatile Organics (µg/L)						
Acetone	67641	< 25	< 25	< 25	< 25	< 25
Acrolein	107028	< 20	< 20	< 20	< 20	< 20
Acrylonitrile	107131	< 10	< 10	< 10	< 10	< 10
Benzene	71432	2.2	< 1	< 1	< 1	< 1
Bromobenzene	108861	< 1	< 1	< 1	< 1	< 1
Bromochloromethane	74975	< 1	< 1	< 1	< 1	< 1
Bromodichloromethane	75274	< 1	< 1	< 1	< 1	< 1
Bromoform	75252	< 1	< 1	< 1	< 1	< 1
n-Butylbenzene	104518	< 1	< 1	< 1	< 1	< 1
sec-Butylbenzene	135988	< 1	< 1	< 1	< 1	< 1
tert-Butylbenzene	98066	< 1	< 1	< 1	< 1	< 1
Chlorobenzene	108907	< 1	< 1	< 1	< 1	< 1
Chloroethane	75003	< 2	< 2	< 2	< 2	< 2
Chloroform	67663	< 1	< 1	< 1	< 1	< 1
o-Chlorotoluene	95498	< 1	< 1	< 1	< 1	< 1
p-Chlorotoluene	106434	< 1	< 1	< 1	< 1	< 1
2-Chloroethyl vinyl ether	110758	< 5	< 5	< 5	< 5	< 5
Carbon disulfide	75150	< 2	< 2	< 2	< 2	< 2
Carbon tetrachloride	56235	< 1	< 1	< 1	< 1	< 1
1,1-Dichloroethane	75343	< 1	< 1	< 1	< 1	< 1
1,1-Dichloroethylene	75354	< 1	< 1	< 1	< 1	< 1
1,1-Dichloropropene	563586	< 1	< 1	< 1	< 1	< 1
1,2-Dibromo-3-chloropropane	96128	< 2	< 2	< 2	< 2	< 2
1,2-Dibromoethane	106934	< 1	< 1	< 1	< 1	< 1
1,2-Dichloroethane	107062	< 1	< 1	< 1	< 1	< 1
1,2-Dichloropropane	78875	< 1	< 1	< 1	< 1	< 1
1,3-Dichloropropane	142289	< 1	< 1	< 1	< 1	< 1
1,4-Dioxane	123911	< 200	< 200	< 200	< 200	< 200
2,2-Dichloropropane	594207	< 1	< 1	< 1	< 1	< 1
Dibromochloromethane	124481	< 1	< 1	< 1	< 1	< 1
Dichlorodifluoromethane	75718	< 2	< 2	< 2	< 2	< 2
cis-1,2-Dichloroethylene	156592	3	1.3	0.52 J	< 1	0.55 J
cis-1,3-Dichloropropene	10061015	< 1	< 1	< 1	< 1	< 1
m-Dichlorobenzene	541731	< 1	< 1	< 1	< 1	< 1
o-Dichlorobenzene	95501	< 1	< 1	< 1	< 1	< 1
p-Dichlorobenzene	106467	< 1	< 1	< 1	< 1	< 1
trans-1,2-Dichloroethylene	156605	< 1	< 1	< 1	< 1	< 1
trans-1,3-Dichloropropene	10061026	< 1	< 1	< 1	< 1	< 1

Table D-2

Surface Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification		SR-SW-1			SR-SW-2			SR-SW-3			SR-SW-4			SR-SW-5		
Sample Date		10/18/2013			10/18/2013			10/18/2013			10/18/2013			10/18/2013		
Sample Type		Investigation			Investigation			Investigation			Investigation			Investigation		
Constituent	CAS No.															
Volatile Organics (µg/L) (continued)																
Ethylbenzene	100414		0.32	J	<	1		<	1		<	1		<	1	
2-Hexanone	591786	<	10		<	10		<	10		<	10		<	10	
Hexachlorobutadiene	87683	<	2		<	2		<	2		<	2		<	2	
Isopropylbenzene	98828	<	1		<	1		<	1		<	1		<	1	
p-Isopropyltoluene	99876	<	1		<	1		<	1		<	1		<	1	
4-Methyl-2-pentanone	108101	<	5		<	5		<	5		<	5		<	5	
Methyl bromide	74839	<	2		<	2		<	2		<	2		<	2	
Methyl chloride	74873	<	2		<	2		<	2		<	2		<	2	
Methylene bromide	74953	<	2		<	2		<	2		<	2		<	2	
Methylene chloride	75092	<	5		<	5		<	5		<	5		<	5	
Methyl ethyl ketone	78933	<	5		<	5		<	5		<	5		<	5	
Methyl Tert Butyl Ether	1634044	<	1		<	1		<	1		<	1		<	1	
Naphthalene	91203	<	3		<	3		<	3		<	3		<	3	
n-Propylbenzene	103651	<	1		<	1		<	1		<	1		<	1	
Styrene	100425	<	1		<	1		<	1		<	1		<	1	
1,1,1,2-Tetrachloroethane	630206	<	1		<	1		<	1		<	1		<	1	
1,1,1-Trichloroethane	71556	<	1		<	1		<	1		<	1		<	1	
1,1,2,2-Tetrachloroethane	79345	<	1		<	1		<	1		<	1		<	1	
1,1,2-Trichloroethane	79005	<	1		<	1		<	1		<	1		<	1	
1,2,3-Trichlorobenzene	87616	<	1		<	1		<	1		<	1		<	1	
1,2,3-Trichloropropane	96184	<	2		<	2		<	2		<	2		<	2	
1,2,4-Trichlorobenzene	120821	<	1		<	1		<	1		<	1		<	1	
1,2,4-Trimethylbenzene	95636	<	2		<	2		<	2		<	2		<	2	
1,3,5-Trimethylbenzene	108678	<	2		<	2		<	2		<	2		<	2	
Tetrachloroethylene	127184	<	1		<	1		<	1		<	1		<	1	
Toluene	108883	<	1		<	1		<	1		<	1		<	1	
Trichloroethylene	79016		3.8			1.4			1.4		<	1			3.7	
Trichlorofluoromethane	75694	<	2		<	2		<	2		<	2		<	2	
Vinyl chloride	75014	<	1		<	1		<	1		<	1		<	1	
Vinyl Acetate	108054	<	10		<	10		<	10		<	10		<	10	
m,p-Xylene	NA	<	2		<	2		<	2		<	2		<	2	
o-Xylene	95476	<	1		<	1		<	1		<	1		<	1	

Notes:
All detection limits based on Reporting Limit (F
NA- Not Available
J- Estimated Value
a- Associated BS recovery outside control limi

Table D-3

Pore Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification	PW-1	PW-2	PW-3	PW-4	PW-5	PW-6
Sample Date	10/4/2013	10/4/2013	10/4/2013	10/4/2013	10/8/2013	10/9/2013
Sample Type	Investigation	Investigation	Investigation	Investigation	Investigation	Investigation
Constituent / CAS No.						
Volatile Organics (µg/L)						
Acetone 67641	< 25	< 25	< 25	< 25	< 25 a	< 25 a
Acrolein 107028	< 20	< 20	< 20	< 20	< 20	< 20
Acrylonitrile 107131	< 10	< 10	< 10	< 10	< 10	< 10
Benzene 71432	< 1	< 1	< 1	< 1	< 1	2.1
Bromobenzene 108861	< 1	< 1	< 1	< 1	< 1	< 1
Bromochloromethane 74975	< 1	< 1	< 1	< 1	< 1	< 1
Bromodichloromethane 75274	< 1	< 1	< 1	< 1	< 1	< 1
Bromoform 75252	< 1	< 1	< 1	< 1	< 1	< 1
n-Butylbenzene 104518	< 1	< 1	< 1	< 1	< 1	< 1
sec-Butylbenzene 135988	< 1	< 1	< 1	< 1	< 1	< 1
tert-Butylbenzene 98066	< 1	< 1	< 1	< 1	< 1	< 1
Chlorobenzene 108907	< 1	< 1	< 1	< 1	< 1	< 1
Chloroethane 75003	< 2	< 2	< 2	< 2	< 2	< 2
Chloroform 67663	< 1	< 1	< 1	< 1	< 1	< 1
o-Chlorotoluene 95498	< 1	< 1	< 1	< 1	< 1	< 1
p-Chlorotoluene 106434	< 1	< 1	< 1	< 1	< 1	< 1
2-Chloroethyl vinyl ether 110758	< 5 a	< 5 a	< 5 a	< 5 a	< 5	< 5
Carbon disulfide 75150	< 2	< 2	< 2	< 2	< 2	< 2
Carbon tetrachloride 56235	< 1	< 1	< 1	< 1	< 1	< 1
1,1-Dichloroethane 75343	< 1	< 1	15.3	< 1	0.32 J	0.45 J
1,1-Dichloroethylene 75354	< 1	< 1	0.85 J	< 1	< 1	< 1
1,1-Dichloropropene 563586	< 1	< 1	< 1	< 1	< 1	< 1
1,2-Dibromo-3-chloropropane 96128	< 2	< 2	< 2	< 2	< 2	< 2
1,2-Dibromoethane 106934	< 1	< 1	< 1	< 1	< 1	< 1
1,2-Dichloroethane 107062	< 1	< 1	< 1	< 1	< 1	< 1
1,2-Dichloropropane 78875	< 1	< 1	< 1	< 1	< 1	< 1
1,3-Dichloropropane 142289	< 1	< 1	< 1	< 1	< 1	< 1
1,4-Dioxane 123911	< 200	< 200	< 200	< 200	< 200	< 200
2,2-Dichloropropane 594207	< 1	< 1	< 1	< 1	< 1	< 1
Dibromochloromethane 124481	< 1	< 1	< 1	< 1	< 1	< 1
Dichlorodifluoromethane 75718	< 2	< 2	< 2	< 2	< 2	< 2
cis-1,2-Dichloroethylene 156592	1.7	< 1	17.2	17.1	10.6	20.1
cis-1,3-Dichloropropene 10061015	< 1	< 1	< 1	< 1	< 1	< 1
m-Dichlorobenzene 541731	< 1	< 1	< 1	< 1	< 1	< 1
o-Dichlorobenzene 95501	< 1	< 1	< 1	< 1	< 1	< 1
p-Dichlorobenzene 106467	< 1	< 1	< 1	< 1	< 1	< 1
trans-1,2-Dichloroethylene 156605	< 1	< 1	< 1	< 1	0.25 J	< 1
trans-1,3-Dichloropropene 10061026	< 1	< 1	< 1	< 1	< 1	< 1

Table D-3

Pore Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	PW-1 10/4/2013 Investigation	PW-2 10/4/2013 Investigation	PW-3 10/4/2013 Investigation	PW-4 10/4/2013 Investigation	PW-5 10/8/2013 Investigation	PW-6 10/9/2013 Investigation
Volatile Organics (µg/L) (continued)							
Ethylbenzene	100414	< 1	< 1	< 1	< 1	< 1	< 1
2-Hexanone	591786	< 10	< 10	< 10	< 10	< 10	< 10
Hexachlorobutadiene	87683	< 2	< 2	< 2	< 2	< 2	< 2
Isopropylbenzene	98828	< 1	< 1	< 1	< 1	< 1	< 1
p-Isopropyltoluene	99876	< 1	< 1	< 1	< 1	< 1	< 1
4-Methyl-2-pentanone	108101	< 5	< 5	< 5	< 5	< 5	< 5
Methyl bromide	74839	< 2	< 2	< 2	< 2	< 2	< 2
Methyl chloride	74873	< 2	< 2	< 2	< 2	< 2	< 2
Methylene bromide	74953	< 2	< 2	< 2	< 2	< 2	< 2
Methylene chloride	75092	< 5	< 5	< 5	< 5	< 5	< 5
Methyl ethyl ketone	78933	< 5	< 5	< 5	< 5	< 5	< 5
Methyl Tert Butyl Ether	1634044	< 1	< 1	< 1	< 1	< 1	< 1
Naphthalene	91203	< 3	< 3	< 3	< 3	< 3	< 3
n-Propylbenzene	103651	< 1	< 1	< 1	< 1	< 1	< 1
Styrene	100425	< 1	< 1	< 1	< 1	< 1	< 1
1,1,1,2-Tetrachloroethane	630206	< 1	< 1	< 1	< 1	< 1	< 1
1,1,1-Trichloroethane	71556	< 1	< 1	6	< 1	< 1	< 1
1,1,2,2-Tetrachloroethane	79345	< 1	< 1	< 1	< 1	< 1	< 1
1,1,2-Trichloroethane	79005	< 1	< 1	< 1	< 1	< 1	< 1
1,2,3-Trichlorobenzene	87616	< 1	< 1	< 1	< 1	< 1	< 1
1,2,3-Trichloropropane	96184	< 2	< 2	< 2	< 2	< 2	< 2
1,2,4-Trichlorobenzene	120821	< 1	< 1	< 1	< 1	< 1	< 1
1,2,4-Trimethylbenzene	95636	< 2	< 2	< 2	< 2	< 2	< 2
1,3,5-Trimethylbenzene	108678	< 2	< 2	< 2	< 2	< 2	< 2
Tetrachloroethylene	127184	< 1	< 1	< 1	< 1	1.3	3.3
Toluene	108883	< 1	< 1	< 1	< 1	< 1	< 1
Trichloroethylene	79016	3.4	2.1	2.5	3.1	24	70.3
Trichlorofluoromethane	75694	< 2	< 2	< 2	< 2	< 2	< 2
Vinyl chloride	75014	< 1	< 1	< 1	< 1	< 1	0.44 J
Vinyl Acetate	108054	< 10	< 10	< 10	< 10	< 10	< 10
m,p-Xylene	NA	< 2	< 2	< 2	< 2	< 2	< 2
o-Xylene	95476	< 1	< 1	< 1	< 1	< 1	< 1
Semi-volatile Organics (µg/L)							
Toxaphene	8001352	< 2.5	< 2.4	< 2.4	< 2.4	< 2.4	< 2.5

Notes:
All detection limits based on Reporting Limit (RL) values.
NA- Not Available
J- Estimated Value
a- Associated BS recovery outside control limits.

Table D-3

Pore Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification / Sample Date / Sample Type / Constituent	CAS No.	PW-7 10/11/2013 Investigation		PW-8 10/11/2013 Investigation		PW-9 10/11/2013 Investigation		PW-10 10/11/2013 Investigation		PW-11 10/11/2013 Investigation	
Volatile Organics (µg/L)											
Acetone	67641	17.3	J	< 25	a	< 25	a	< 25	a	< 25	a
Acrolein	107028	< 20		< 20		< 20		< 20		< 20	
Acrylonitrile	107131	< 10		< 10		< 10		< 10		< 10	
Benzene	71432	11.1		0.43	J	4.9		< 1		2.2	
Bromobenzene	108861	< 1		< 1		< 1		< 1		< 1	
Bromochloromethane	74975	< 1		< 1		< 1		< 1		< 1	
Bromodichloromethane	75274	< 1		< 1		< 1		< 1		< 1	
Bromoform	75252	< 1		< 1		< 1		< 1		< 1	
n-Butylbenzene	104518	< 1		< 1		< 1		< 1		< 1	
sec-Butylbenzene	135988	< 1		< 1		< 1		< 1		< 1	
tert-Butylbenzene	98066	< 1		< 1		< 1		< 1		< 1	
Chlorobenzene	108907	< 1		< 1		< 1		< 1		< 1	
Chloroethane	75003	< 2		< 2		< 2		< 2		< 2	
Chloroform	67663	< 1		< 1		< 1		< 1		< 1	
o-Chlorotoluene	95498	< 1		< 1		< 1		< 1		< 1	
p-Chlorotoluene	106434	< 1		< 1		< 1		< 1		< 1	
2-Chloroethyl vinyl ether	110758	< 5		< 5		< 5		< 5		< 5	
Carbon disulfide	75150	< 2		< 2		< 2		< 2		< 2	
Carbon tetrachloride	56235	< 1		< 1		< 1		< 1		< 1	
1,1-Dichloroethane	75343	0.23	J	0.32	J	0.28	J	< 1		< 1	
1,1-Dichloroethylene	75354	< 1		< 1		< 1		< 1		< 1	
1,1-Dichloropropene	563586	< 1		< 1		< 1		< 1		< 1	
1,2-Dibromo-3-chloropropane	96128	< 2		< 2		< 2		< 2		< 2	
1,2-Dibromoethane	106934	< 1		< 1		< 1		< 1		< 1	
1,2-Dichloroethane	107062	< 1		< 1		< 1		< 1		< 1	
1,2-Dichloropropane	78875	< 1		< 1		< 1		< 1		< 1	
1,3-Dichloropropane	142289	< 1		< 1		< 1		< 1		< 1	
1,4-Dioxane	123911	< 200		< 200		< 200		< 200		< 200	
2,2-Dichloropropane	594207	< 1		< 1		< 1		< 1		< 1	
Dibromochloromethane	124481	< 1		< 1		< 1		< 1		< 1	
Dichlorodifluoromethane	75718	< 2	a	< 2	a	< 2	a	< 2	a	< 2	a
cis-1,2-Dichloroethylene	156592	0.59	J	5.5		4.7		0.27	J	3.3	
cis-1,3-Dichloropropene	10061015	< 1		< 1		< 1		< 1		< 1	
m-Dichlorobenzene	541731	< 1		< 1		< 1		< 1		< 1	
o-Dichlorobenzene	95501	< 1		< 1		< 1		< 1		< 1	
p-Dichlorobenzene	106467	< 1		< 1		< 1		< 1		< 1	
trans-1,2-Dichloroethylene	156605	< 1		< 1		< 1		< 1		< 1	
trans-1,3-Dichloropropene	10061026	< 1		< 1		< 1		< 1		< 1	

Table D-3

Pore Water Analytical Data
Clean Harbors Kansas, LLC- Wichita, Kansas

Sample Identification		PW-7			PW-8			PW-9			PW-10			PW-11		
Sample Date		10/11/2013			10/11/2013			10/11/2013			10/11/2013			10/11/2013		
Sample Type		Investigation			Investigation			Investigation			Investigation			Investigation		
Constituent	CAS No.															
Volatile Organics (µg/L) (continued)																
Ethylbenzene	100414		0.34	J		0.6	J		0.52	J	<	1		<	1	
2-Hexanone	591786	<	10		<	10		<	10		<	10		<	10	
Hexachlorobutadiene	87683	<	2		<	2		<	2		<	2		<	2	
Isopropylbenzene	98828		1.9		<	1		<	1		<	1		<	1	
p-Isopropyltoluene	99876	<	1		<	1		<	1		<	1		<	1	
4-Methyl-2-pentanone	108101	<	5		<	5		<	5		<	5		<	5	
Methyl bromide	74839	<	2		<	2		<	2		<	2		<	2	
Methyl chloride	74873	<	2		<	2		<	2		<	2		<	2	
Methylene bromide	74953	<	2		<	2		<	2		<	2		<	2	
Methylene chloride	75092	<	5		<	5		<	5		<	5		<	5	
Methyl ethyl ketone	78933		6.1		<	5		<	5		<	5		<	5	
Methyl Tert Butyl Ether	1634044		15.4			0.35	J		0.32	J		1.4			0.22	J
Naphthalene	91203	<	3		<	3		<	3		<	3		<	3	
n-Propylbenzene	103651	<	1		<	1			0.41	J	<	1		<	1	
Styrene	100425	<	1		<	1		<	1		<	1		<	1	
1,1,1,2-Tetrachloroethane	630206	<	1		<	1		<	1		<	1		<	1	
1,1,1-Trichloroethane	71556	<	1			0.25	J	<	1		<	1		<	1	
1,1,2,2-Tetrachloroethane	79345	<	1		<	1		<	1		<	1		<	1	
1,1,2-Trichloroethane	79005	<	1		<	1		<	1		<	1		<	1	
1,2,3-Trichlorobenzene	87616	<	1		<	1		<	1		<	1		<	1	
1,2,3-Trichloropropane	96184	<	2		<	2		<	2		<	2		<	2	
1,2,4-Trichlorobenzene	120821	<	1		<	1		<	1		<	1		<	1	
1,2,4-Trimethylbenzene	95636	<	2			0.29	J		0.23	J	<	2		<	2	
1,3,5-Trimethylbenzene	108678	<	2		<	2		<	2		<	2		<	2	
Tetrachloroethylene	127184	<	1			0.66	J		0.53	J	<	1			0.4	J
Toluene	108883		0.52	J	<	1		<	1			0.76	J	<	1	
Trichloroethylene	79016	<	1			6.8			5.1		<	1			3.3	
Trichlorofluoromethane	75694	<	2		<	2		<	2		<	2		<	2	
Vinyl chloride	75014	<	1			0.44	J	<	1		<	1		<	1	
Vinyl Acetate	108054	<	10		<	10		<	10		<	10		<	10	
m,p-Xylene	NA		0.63	J		0.57	J		0.46	J	<	2		<	2	
o-Xylene	95476	<	1		<	1		<	1			0.2	J	<	1	
Semi-volatile Organics (µg/L)																
Toxaphene	8001352	<	2.5		<	2.5		<	2.4		<	2.5		<	2.5	

Notes:
All detection limits based on Reporting Limit (RL) values.
NA- Not Available
J- Estimated Value
a- Associated BS recovery outside control limits.